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DEPARTMENT OF THE INTERIOR

BULLETIN

OF THE

UNITED STATES

GEOLOGICAL SURVEY

No. 123

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NG OFFICE

278056

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

A

DICTIONARY OF GEOGRAPHIC POSITIONS

IN

THE UNITED STATES

COMPILED BY

HENRY GANNETT

CHIEF TOPOGRAPHER

WASHINGTON
GOVERNMENT PRINTING OFFICE
1895

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF TOPOGRAPHY,
Washington, D. C., November 23, 1894.

SIR: I beg to transmit herewith, for publication as a bulletin, a compilation of positions determined within the limits of the United States.

Very respectfully,

HENRY GANNETT,
Chief Topographer.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

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A DICTIONARY OF GEOGRAPHIC POSITIONS.

By Henry Gannett.

INTRODUCTION.

For several years the Division of Topography of the United States Geological Survey has been engaged in compiling positions determined within the United States which are believed to be of sufficient accuracy for use in the preparation of its maps. This compilation has been found extremely useful in the office, and it is believed that its usefulness will be greatly extended by placing it before the public.

This list comprises between 9,000 and 10,000 positions. To publish it in extenso, with descriptions of the stations, their latitudes and longitudes, the distances and azimuths to neighboring stations, and the methods of determination, would extend this bulletin beyond all reasonable limits. To avoid making too bulky a volume, it has been decided to publish merely the latitudes and longitudes, with abbreviations indicating the authority, and references to the publications in which other data relating to the positions may be found.

The arrangement of these positions is the result of much thought, and that presented is believed to be the most convenient for the purposes for which such a compilation is needed. The positions are arranged by States and, within States, by "square degrees;" i. e., the quadrilateral limited by consecutive parallels and meridians. The States are arranged geographically, beginning with Maine and ending with California. Within the States the square degrees commence with the northeasternmost and run westward across the State; then they begin again with the eastern end of the next tier southward, and so on to the southwest corner of the State.

Within each square degree the positions are arranged alphabetically by name. The only exception to this is in the case of section corners in certain States on the prairies and plains. These section corners will be found at the end of their respective square degrees.

The controlling reason for the selection of this method of arrangement is that the most common requirement is for all positions within a certain area, and since that area may be large, such as the area of the State, or small, as, for instance, the neighborhood of a city, such

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IN

THE UNITED STATES

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HENRY GANNETT
CHIEF TOPOGRAPHER

WASHINGTON
GOVERNMENT PRINTING OFFICE
1895

Determinations in the Rocky Mountain region will be found to exhibit discrepancies of magnitude. These are due to two causes; one, the fact that certain organizations have used the Bessels spheroid and the others that of Clarke. The discrepancies due to this cause are, however, small in amount, ranging from one to three seconds of latitude and longitude. The other source of discrepancy is due to station errors. The station errors in this region are often large, owing to the high relief of the country. In certain cases they are known to be as great as a fourth of a mile, and further investigation will doubtless develop much larger ones. These can not be adjusted until numerous astronomical determinations, scattered widely over the country, have been connected by triangulation and mean results obtained to which all determinations may be reduced.

NEW YORK STATE SURVEY.

This organization, under the directorship of Mr. James T. Gardiner, executed a large amount of geodetic work in that State during the fourteen years of its existence, 1874 to 1887, inclusive. This work is of a high order, amply sufficient for maps upon almost any scale for which they may be required. The results are upon the Clarke spheroid.

The abbreviation used for this authority is "S. S.," and the reference is to the final report of the Survey.

LIST OF POSITIONS.

MAINE.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			69°-70°				
	°	′	″	°	′	″		
Bigelow	44	42	47.91	69	43	39.72	G. S	Bull. 122.
Blin		07	14.72		40	52.26	C. & G. S	
Bowman		32	31.67		41	56.60	G. S	Do.
Costellow		02	52.89		46	07.01	C. & G. S	
Hornbeam		28	32.84		57	06.58	G. S	Do.
Houdlette		05	02.42		46	15.46	C. & G. S	
Iron Hill		12	45.95		47	07.66	do	
Layton Hill		10	22.86		45	50.25	do	
Marco		35	21.72		38	49.84	G. S	Do.
Maxwell		02	12.93		50	35.66	C. & G. S	
Merserve		08	44.79		44	29.27	do	
Monks Hill		21	36.25		53	00.15	G. S	Do.
Quaker		26	08.63		46	30.63	do	Do.
Telegraph Hill		10	28.12		44	43.49	C. & G. S	
Winter		16	54.54		44	27.94	G. S	Do.
	44°-45°			70°-71°				
Mount Blue	44	43	41.43	70	20	33.16	C. & G. S	
Pisgah		18	22.67		01	27.66	do	Do.
Sabattus		08	37.83		04	43.74	do	Do.
	43°-44°			69°-70°				
Cushman	43	58	44.04	69	40	46.62	do	
Edgecomb		57	13.76		36	18.53	do	
Great Hill		53	46.92		51	14.54	do	
Haggett		59	44.31		36	18.62	do	
Hodgkins		58	43.48		48	48.18	do	
Norwood		59	54.33		33	56.38	do	
Sprague		58	31.90		53	64.89	do	
	43°-44°			70°-71°				
Adams	43	52	53.95	70	23	28.51	G. S	Do.
Agamenticus		13	24.63		41	32.91	C. & G. S	Do.
Bauneg Beg		23	03.18		47.	07.26	G. S	Do.
Biddeford:								
New slate spire		29	38.00		27	40.80	do	
Congregational church spire		29	34.20		27	26.59	do	
Tall spire		29	31.80		27	32.64	C. & G. S	
Baptist church spire		29	40.50		27	30.53	do	
Billings Hill		04	03.13		41	30.66	do	
Bradbury		54	08.01		10	56.36	do	
Cape Elizabeth:								
West light-house (1874)		33	51.57		12	11.04	do	
East light-house (1874)		33	58.15		12	02.43	do	
East Sister		04	06.48		40	01.04	do	
Farnham		30	05.77		55	47.06	G. S	Do.
Fort Sullivan		04	32.64		44	00.94	C. & G. S	
Fort Washington		04	26.21		44	27.57	do	
Freeport:								
Church		51	28.13		06	12.86	do	
Dark spire		51	45.53		06	03.35	do	
Frost Hill		09	45.00		47	23.93	do	
Gorham		40	50.60		26	49.96	G. S	Do.
Groveville church spire		39	52.90		31	10.60	do	
Kennebunk:								
Town clock		23	16.70		32	15.90	do	
Spire		23	13.10		32	15.10	do	
Kittery Point		04	44.60		42	52.72	C. & G. S	
Mount Independence		45	33.75		19	14.34	do	Do.
Mount Pleasant		01	36.69		59	21.94	do	
Munjoy		39	55.64		14	55.64	do	Do.
Ossipee		35	18.87		44	27.66	do	Do.
Portland Head light-house		37	23.51		12	30.23	do	

MAINE—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			70°-71°				
	°	′	″	°	′	″		
Rattlesnake, wooded summit	43	58	01.10	70	29	10.90	G. S	Bull. 122.
Saco, church		30	02.96		26	35.06	C. & G. S	
Sawyer		44	41.00		45	13.06	G. S	
Sebago Hill, tall dead tree		50	40.20		43	48.00	do	
Sebago Bald Hill, pine tree		51	53.30		41	57.30	do	
Seward		04	11.19		40	44.91	C. & G. S	
Tare Shirt		19	15.90		49	20.85	G. S	Do.
West Sister		03	42.98		40	21.62	C. & G. S	
Whale Back		03	31.59		41	49.26	do	
Light-house (1878)		03	31.80		41	48.56	do	
Light-house (1850)		03	31.70		41	49.05	do	
Wood Island		03	46.23		41	52.34	do	
White Island		03	35.42		41	20.10	do	
Windham, church		47	50.70		25	26.60	G. S	
Wood Island light-house		27	24.70		19	46.25	C. & G. S	
Wooded Knob		54	16.00		39	18.60	G. S	
Yarmouth:								
Yellow spire		48	12.70		11	47.07	C. & G. S	
White spire		47	58.28		11	01.80	do	
York		46	43.45		11	08.88	do	
	42°-43°			70°-71°				
Isle of Shoals, Hog Island	42	59	14.86	70	36	50.28	do	

NEW HAMPSHIRE.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			71°-72°				
	°	′	″	°	′	″		
Agassiz	44	15	58.17	71	40	38.05	G. S	Bull. 122.
Carrigain		05	37.23		26	50.87	do	Do.
Ingalls		28	16.90		02	22.00	C. & G. S	
Iron Mountain		08	03.02		14	22.65	G. S	Do.
Kearsarge		06	21.06		05	41.12	do	Do.
Lafayette		09	38.92		38	41.66	C. & G. S	Do.
Moat		02	35.70		12	55.18	G. S	Do.
Moriah		20	24.90		07	55.40	C. & G. S	
Mount Washington:								
Chimney		16	14.44		18	11.49	do	Do.
Tower		16	14.06		18	13.65	do	Do.
Prospect Hill		27	05.88		34	16.80	G. S	Do.
South Baldface		13	51.46		04	42.45	do	Do.
Starr King		26	04.50		25	59.80	C. & G. S	Do.
	43°-44°			70°-71°				
Blunt Island	43	03	25.95	70	43	53.46	do	
Boatswain Hill		03	57.17		43	26.43	do	
Clark Island		04	34.36		43	28.63	do	
Clark Island, 2		04	37.30		43	28.50	do	
Fort Constitution		04	18.06		42	34.67	do	
Foss Rye		00	45.81		44	21.28	do	
Frost Hill		03	35.25		43	36.27	do	
Frost Point		03	11.01		43	10.86	do	
Garrison		12	34.63		52	12.71	do	
Jerrys Fort		03	26.92		42	45.66	do	
Newcastle		03	37.10		43	20.49	do	
Portsmouth Harbor:								
Northwest base (1842)		02	55.73		43	14.19	do	
Newcastle light-house (1850-1878)		04	16.10		42	32.92	do	
Pulpit Rock		01	58.54		43	08.31	do	
Salter Island		03	57.00		44	49.78	do	
Stratham Hill		02	22.53		53	26.26	do	
Tower		04	13.70		42	45.68	do	
Wentworth Height		03	41.46		44	29.38	do	
	43°-44°			71°-72°				
Chocorua	43	57	16.17	71	16	26.36	G. S	
Patuccawa		07	13.69		11	51.32	C. & G. S	Rept. '85.
	43°-44°			72°-73°				
Hanover	43	42	15.20	72	17	07.95	do	
Observatory Hill, New Dartmouth College.		42	19.79		17	08.07	do	
	42°-43°			70°-71°				
Great Boars Head	42	55	05.43	70	47	45.93	do	
Hampton		56	33.94		49	37.92	do	
Hampton Falls		54	44.37		53	51.88	do	
Little Boars Head		57	28.88		46	33.80	do	
Seabrook		52	29.59		49	06.55	do	

NEW HAMPSHIRE—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
	°	′	″	°	′	″		
Philbrick	42	56	59.66	71	07	14.70	C. & G. S	
Unkonoonuc		58	59.86		35	19.38	do	
	42°-43°			72°-73°				
Monadnock	42	51	41.17	72	06	30.78	do	

VERMONT.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			72°-73°				
	°	′	″	°	′	″		
Potato Hill	44	07	13.69	72	56	12.04	C. & G. S	
	44°-45°			73°-74°				
Apple Tree Point	44	29	50.37	73	16	27.77	do	
Barber Hill		18	10.20		15	33.44	do	
Comstock Hill		23	26.66		15	40.46	do	
Fields Hill		12	30.92		13	59.58	do	
Head		49	49.65		20	35.59	do	
Hen Island		49	22.00		16	20.26	do	
Hill		52	42.35		20	01.76	do	
Island La Motte light-house		54	23.46		20	38.16	do	
Juniper Island		26	57.70		16	39.23	do	
Sawyer Island		39	00.63		21	21.05	do	
Saxton Point		23	48.44		16	45.11	do	
Smith		00	34.83		22	22.85	do	
Snake Mountain tower		03	41.91		16	52.11	do	
Whitford		04	16.32		17	31.84	do	
Windmill Point light-house		58	54.65		20	32.26	do	
	43°-44°			72°-73°				
Ascutney	43	26	46.74	72	27	08.48	do	
Colton		57	10.24		22	03.21	do	
Gile		47	20.78		21	07.33	do	
Glebe		11	20.23		45	41.10	do	
Goshen		49	46.72		58	16.87	do	
Killington		36	17.50		49	14.28	do	
Rochester		52	01.29		44	55.15	do	
Styles		16	25.20		56	18.41	do	
West Hawks		22	04.86		34	50.60	do	
	43°-44°			73°-74°				
Fletcher	43	59	27.01	73	18	41.26	do	
Forbes		29	28.26		19	46.83	do	
French		47	55.50		21	43.16	do	
Herrick (1882)		33	45.67		05	58.07	do	
Landon		47	41.04		11	05.51	do	
Mount Defiance		49	53.15		24	25.45	do	
Mount Equinox		09	57.98		07	02.71	do	
Northeast		26	07.49		10	02.75	do	
Poultney, Baptist church		30	57.02		14	16.17	do	
Rupert		18	28.23		12	00.46	G. S	
Sisson Hill		52	59.72		19	50.60	do	
Wilson		43	17.55		20	45.57	do	
	42°-43°			72°-73°				
Chesterfield	42	53	23.15	72	26	23.11	do	
Halifax		46	30.79		43	27.67	C. & G. S	
Haystack		54	50.09		55	10.55	do	
White Hill		59	17.68		48	18.61	do	

MASSACHUSETTS.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43.			70°-71°				
	°	′	″	°	′	″		
Abbott Rock, stone beacon	42	31	49.48	70	51	46.34	C. & G. S	Rept. '85.
Amesbury Mills, tall white spire		51	21.38		55	58.58	do	Do.
Andrew Point		40	58.98		37	46.80	do	Do.
Annisquam Harbor, light-house		39	43.02		40	55.29	do	Do.
Annisquam, pole on rock		39	26.92		40	39.62	do	Do.
Apple Island, flag		21	31.55		59	32.43	do	Do.
Atlantic House, chimney		16	03.02		50	53.05	do	Do.
Bailey Wharf		48	42.94		51	56.55	do	Do.
Baker Island, light-house		32	11.53		47	11.22	do	Do.
Baker Hill		14	35.94		54	28.47	do	Do.
Ballard		27	17.56		59	32.57	do	Do.
Barrel Beacon		19	22.27		55	09.18	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Bartlett	42	50	04.46	70	55	23.74	C. & G. S	Rept. '85.
Batt Hill		52	15.86		53	32.60	do	Do.
Beacon Hill, 1		36	24.94		38	43.01	do	Do.
Beacon Hill, 2		36	11.74		38	38.64	do	Do.
Beacon Hill, magnetic station		36	22.79		38	46.85	do	Do.
Belle Isle		22	57.30		59	56.35	do	Do.
Beverly:								
Powder house		33	12.60		52	33.13	do	Do.
Tall spire, with turrets		32	51.06		52	43.52	do	Do.
Beverly Point, flag in tree		32	59.04		54	15.46	do	Do.
Beverly rocks		33	58.78		50	14.98	do	Do.
Bluff Head, flag		22	03.82		58	04.53	do	Do.
Black Rock		16	08.56		49	28.42	do	Do.
Bolles		35	05.95		47	35.44	do	Do.
Bonney		03	10.50		52	34.01	do	Do.
Boston, light-house		19	40.74		53	26.18	do	Do.
Bowlder, west of Salem Turnpike		30	21.92		56	07.38	do	Do.
Bowditch Ledge, beacon		32	25.38		48	43.19	do	Do.
Brant		05	17.32		38	28.70	do	Do.
Breakwater, east end, spindle		37	27.31		17	34.06	do	Do.
Brookhouse House		29	08.56		53	13.76	do	Do.
Brown Hill		36	45.69		50	49.98	do	Do.
Bunkin Island, flag		16	51.86		54	02.85	do	Do.
Burnham Brown, flag		39	32.00		49	25.88	do	Do.
Butler Hill		39	29.50		40	18.33	do	Do.
Byfield church, square tower		44	19.04		55	53.81	do	Do.
Cape Ann, north light-house		38	21.25		34	31.05	do	Do.
Cape Ann, south light-house		38	12.82		34	31.78	do	Do.
Cape Cod, or Highlands of Truro, light-house.		02	23.16		03	39.83	do	Do.
Carolina Hill		06	58.52		43	52.85	do	Do.
Cat Hill		13	19.18		45	20.32	do	Do.
Cat Island:								
East rock		30	32.61		48	45.00	do	Do.
Flagstaff		30	43.52		48	55.42	do	Do.
Choate		39	55.52		45	40.80	do	Do.
Church spire, summer house		28	55.14		53	03.45	do	Do.
Clift		09	29.08		45	05.26	do	Do.
Coddon		30	59.17		51	17.52	do	Do.
Coney Island, flag		31	42.89		50	14.78	do	Do.
Cohasset church		14	35.63		48	14.02	do	Do.
Crane Neck		46	13.67		58	31.75	do	Do.
Crow Point		15	41.98		53	46.47	do	Do.
Crusoe House, flagstaff		26	10.65		58	07.58	do	Do.
Danvers Insane Asylum, tower		34	51.74		58	30.82	do	Do.
Danvers New Mills, tall spire		33	20.70		55	30.55	do	Do.
Danvers Plain, tall spire		34	03.32		56	18.26	do	Do.
Deer Island		21	01.28		57	30.99	do	Do.
Beacon		20	23.44		57	18.41	do	Do.
Flag		21	01.24		57	30.95	do	Do.
Hospital cupola		21	12.39		57	53.15	do	Do.
Dexter Point		32	53.80		50	44.26	do	Do.
Derby Wharf, light-house		30	59.91		53	02.54	do	Do.
Dodge Hotel, cupola		32	02.86		53	49.30	do	Do.
Dogtown, Methodist church		38	04.86		40	33.09	do	Do.
Dread Ledge, beacon		27	23.19		53	43.54	do	Do.
Dummer Academy		45	16.29		53	59.58	do	Do.
Duxbury, astronomic station		02	55.18		40	10.96	do	Do.
Eagle Island		31	31.21		48	49.24	do	Do.
East Duxbury, belfry		02	08.10		40	24.05	do	Do.
Eastern Point, light-house		34	49.14		39	53.90	do	Do.
East Weymouth, church		12	50.40		55	31.08	do	Do.
Eaton Hill		15	44.08		59	53.43	do	Do.
Egg Rock		26	00.40		53	53.34	do	Do.
Light-house		26	00.76		53	54.02	do	Do.
Essex, powder house		38	19.16		47	18.24	do	Do.
Essex, red-top church		37	59.96		46	53.16	do	Do.
Fawn Beacon		21	17.58		56	32.87	do	Do.
Florence, Cosmian Hall clock tower		20	09.26		40	26.55	do	Do.
Folly Hill		33	59.12		54	48.20	do	Do.
Fort Lee		31	54.71		52	28.94	do	Do.
Fort Pickering, light-house		31	35.57		52	01.07	do	Do.
Fort Warren, west gable of house		19	13.10		55	42.40	do	Do.
Gallop Island, flag		19	37.30		56	21.48	do	Do.
Gallop Island, 2		19	37.97		56	23.16	do	Do.
George Island		19	11.16		55	42.32	do	Do.
Gloucester:								
Church		37	00.46		39	25.66	do	Do.
Universalist church		36	47.66		40	00.14	do	Do.
Grape Island, flag		16	07.28		55	27.21	do	Do.
Graves		21	53.66		52	12.61	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Great Aquavitæ	42	31	34.58	70	51	28.24	C. & G. S	Rept. '85.
Great Brewster		20	01.96		53	45.18	do	Do.
Great Brewster, 2		20	01.68		53	45.22	do	Do.
Great Haste		32	05.29		50	32.51	do	Do.
Great Misery, flag		32	50.20		47	49.23	do	Do.
Great Quincy		16	29.03		57	06.87	do	Do.
Green Island, flag		21	11.17		53	33.01	do	Do.
Green Island, 2		21	11.14		53	33.02	do	Do.
Grose		09	53.90		52	43.52	do	Do.
Grover Cliff		23	22.79		58	08.65	do	Do.
Gurnet		00	11.40		36	06.05	do	Do.
Gurnet, light-house		00	12.30		36	04.03	do	Do.
Halfway Rock, beacon		30	09.38		46	31.40	do	Do.
Hangman Ledge, beacon		17	44.75		57	39.22	do	Do.
Hardy Rock, beacon		32	11.36		48	01.62	do	Do.
Hatch		08	08.48		42	11.36	do	Do.
Hayden's Hotel		15	10.37		46	20.13	do	Do.
Highland		01	41.33		02	47.49	do	Do.
Hingham:								
Church with clock		14	34.32		53	29.43	do	Do.
Great Plains church		12	38.35		53	04.50	do	Do.
Old Colony house, cupola		14	51.75		52	22.62	do	Do.
Old church		14	26.68		53	14.96	do	Do.
Hull:								
Oregon House, cupola		18	12.14		54	47.44	do	Do.
Steamboat Hotel, cupola		18	16.26		55	08.29	do	Do.
Hospital Point, light-house		32	47.60		51	23.29	do	Do.
Indian Hill, flagstaff		47	03.22		56	54.40	do	Do.
Ipswich:								
Beacon		41	07.56		45	59.91	do	Do.
Light-house		41	06.81		46	07.32	do	Do.
Tall dark spire		40	53.18		50	11.70	do	Do.
Town farm		43	03.92		50	52.09	do	Do.
Jones		09	28.84		50	01.88	do	Do.
Kettle Island		34	01.26		43	22.00	do	Do.
Kimball's house, center chimney		20	19.12		53	26.75	do	Do.
King Oak Hill, pole		13	38.94		56	25.32	do	Do.
Lane Cove, white spire		40	41.55		39	15.88	do	Do.
Legg Hill		29	23.30		53	30.83	do	Do.
Lewis		08	09.45		43	13.69	do	Do.
Little Aquavitæ, pole		31	34.78		51	13.10	do	Do.
Little Haste, beacon		32	07.71		50	35.95	do	Do.
Little Nahant		26	13.27		55	52.09	do	Do.
Little Oldtown		46	24.87		50	32.24	do	Do.
Londoner Beacon		38	06.26		33	59.33	do	Do.
Long Island Head, light-house		19	48.13		57	24.12	do	Do.
Long Island Hotel, cupola		19	27.40		57	53.39	do	Do.
Long Island, south end		18	39.52		58	37.16	do	Do.
Long Island, south end, 2		18	39.60		58	36.88	do	Do.
Long Point:								
Light-house		01	59.47		10	09.01	do	Do.
Schoolhouse		01	21.71		10	55.15	do	Do.
Lovell Island		19	48.60		55	50.36	do	Do.
Lufkin Hill		38	16.08		44	40.86	do	Do.
Lynn, east church, green tower		28	07.12		56	16.41	do	Do.
Lynn:							do	Do.
High rock		28	04.96		56	52.10	do	Do.
West church turret		27	45.71		57	37.00	do	Do.
Manchester, church, with dark spire		34	30.28		46	20.82	do	Do.
Manning Hill		42	30.26		48	23.32	do	Do.
Marblehead:								
Black-top church		30	25.66		50	54.11	do	Do.
Light-house		30	19.76		50	03.02	do	Do.
Neck		29	46.94		50	29.04	do	Do.
Rock, beacon		30	11.95		49	34.48	do	Do.
Marshfield cupola		09	25.12		44	33.34	do	Do.
Milk Island		37	41.64		35	31.80	do	Do.
Minot Ledge light-house		16	11.16		45	34.71	do	Do.
Moonhead, 1		18	22.20		59	23.06	do	Do.
Moonhead, 2		18	22.04		59	23.13	do	Do.
Morrill		49	15.65		51	06.50	do	Do.
Mouth of Merrimac, chimney of house		49	13.63		49	18.14	do	Do.
Mount Hope		11	34.97		49	18.00	do	Do.
Nahant, hotel cupola		25	09.20		54	19.84	do	Do.
Nantasket		18	15.69		54	20.20	do	Do.
Nantucket Cliff, range beacon		17	37.96		06	24.12	do	Do.
Newbury:								
Belleville church		49	06.77		53	24.84	do	Do.
Upper green church		47	58.56		51	46.19	do	Do.
Newburyport:								
Academy		48	31.79		52	28.89	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Newburyport—Continued.								
Beacon on north pier	42	48	49.26	70	51	28.43	C. & G. S.	Rept. '85.
Federal Street church		48	30.56		51	59.57	do	Do.
Harris Street church		48	31.71		52	23.74	do	Do.
Newburyport light-house		48	54.76		49	10.42	do	Do.
Newburyport Unitarian church		48	38.42		52	19.21	do	Do.
Neptune House, flagstaff		25	43.48		58	46.76	do	Do.
Nix's Mate		19	53.35		56	40.94	do	Do.
North Gooseberry Island		31	35.97		47	39.19	do	Do.
North Marshfield Unitarian church spire.		08	30.15		44	29.46	do	Do.
North Pettick Island		18	06.28		55	47.57	do	Do.
North Pettick Island, 2		18	06.32		55	47.73	do	Do.
North Weymouth, church		13	46.46		56	42.94	do	Do.
Ocean House, cupola		28	53.73		52	33.64	do	Do.
Oldtown		46	07.58		51	00.90	do	Do.
Oldtown church spire		47	58.49		51	46.19	do	Do.
Orne		30	10.26		57	54.45	do	Do.
Outer Brewster, 2		20	29.33		52	41.21	do	Do.
Ox Pasture Hill		44	17.08		52	55.00	do	Do.
Paine Hill, observatory		14	01.56		59	42.96	do	Do.
Parker Hill		13	45.60		46	49.55	do	Do.
Pamet		00	14.91		04	52.68	do	Do.
Pig Rock beacon		16	44.04		56	22.65	do	Do.
Pincin Hill		11	21.07		46	45.42	do	Do.
Plum Island, 1		46	37.02		48	17.72	do	Do.
Plum Island, 2		44	27.80		47	33.78	do	Do.
Plum Island magnetic station		47	59.94		48	49.34	do	Do.
Plymouth light-house		00	12.30		36	04.03	do	Do.
Point Allerton beacon		18	47.08		53	00.29	do	Do.
Point Allerton flag		18	37.12		52	59.36	do	Do.
Point Shirley, foundry chimney		21	31.80		58	20.22	do	Do.
Poole Hill		39	24.69		38	05.77	do	Do.
Powow		51	57.01		56	18.81	do	Do.
Powder Point		02	49.15		39	10.75	do	Do.
Prospect:								
Hingham		11	34.69		51	27.16	do	Do.
Rowley		42	19.15		53	33.13	do	Do.
Provincetown		03	08.45		11	20.53	do	Do.
Academy		03	09.78		11	14.50	do	Do.
Baptist church belfry		03	27.45		10	39.74	do	Do.
Methodist church belfry		03	06.52		11	17.82	do	Do.
Methodist Centenary church		02	52.44		11	26.78	do	Do.
New Universalist church spire		03	02.08		11	19.94	do	Do.
Orthodox church spire		03	04.03		11	17.61	do	Do.
Schoolhouse		02	41.17		11	36.90	do	Do.
Quincy:								
Bent Point church		14	45.75		58	31.97	do	Do.
Black-top church		15	00.66		59	49.90	do	Do.
Race		04	50.41		12	26.65	do	Do.
Race Point light-house		03	44.56		14	36.99	do	Do.
Railcut Hill		37	42.87		38	58.40	do	Do.
Rainsford Island:								
Flag		18	46.91		57	07.12	do	Do.
Flagstaff		18	46.83		57	07.41	do	Do.
Rockland church		07	48.98		54	56.63	do	Do.
Rockland House, cupola		15	56.90		51	10.05	do	Do.
Rockport, red-top church		39	28.80		37	09.70	do	Do.
Rowley:								
Church spire with turrets		42	59.02		52	42.38	do	Do.
Marsh		44	37.76		50	16.33	do	Do.
Sagamore Head		16	24.46		51	50.04	do	Do.
Salem:								
South church, corner Cambridge and Chesnut streets.		31	12.02		53	59.36	do	Do.
Howard street church		31	28.12		53	34.04	do	Do.
Salisbury church		50	33.98		51	38.96	do	Do.
Salisbury Beach		50	49.10		49	03.44	do	Do.
Salisbury Marsh		52	18.68		49	14.68	do	Do.
Salt Island, flag		37	11.38		37	26.60	do	Do.
Salvage		40	20.24		34	05.94	do	Do.
Scituate		14	14.65		49	51.23	do	Do.
Light-house		12	17.32		42	58.74	do	Do.
Unitarian church		12	00.69		45	22.19	do	Do.
South Abington		04	49.67		56	34.24	do	Do.
South Danvers, tall spire		31	35.38		55	40.55	do	Do.
South Pettick Island		17	23.82		56	51.66	do	Do.
Spectacle Island, flag		19	38.90		59	16.66	do	Do.
Sprague		00	17.90		58	00.11	do	Do.
Standish		00	50.77		40	58.21	do	Do.
Monument		00	50.24		40	57.66	do	Do.
Stout		04	09.52		07	32.83	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			70°-71°				
	°	′	″	°	′	″		
Straitsmouth light-house	42	39	44.37	70	35	19.15	C. & G. S	Rept. '85.
Strawberry Hill, barn		17	22.52		52	49.47	do	Do.
Studley		08	13.49		48	07.38	do	Do.
Summerhouse on high rock		28	05.06		56	48.86	do	Do.
Swampscott, church		28	06.14		54	58.40	do	Do.
Ten Pound Island light-house		36	06.66		39	57.58	do	Do.
Thatcher Island		38	10.94		34	46.28	do	Do.
Thayer Hill, yellow house chimney		13	51.49		58	10.55	do	Do.
Thompson		36	41.92		43	49.16	do	Do.
Tinker Island, pole on house		28	57.71		50	07.28	do	Do.
Turkey Hill		14	25.68		51	14.22	do	Do.
Twopenny Loaf, flag		39	36.80		43	08.84	do	Do.
Upper Harbor, inner beacon		48	40.70		51	59.70	do	Do.
Do		48	41.70		51	55.25	do	Do.
Ware Hill, flagstaff		30	40.60		54	32.79	do	Do.
Webster (Hon. D.):								
West chimney on house		03	48.26		40	47.07	do	Do.
Flagstaff		04	39.21		40	13.77	do	Do.
Weeks, house chimney		20	21.21		53	49.02	do	Do.
West Duxbury, Unitarian church steeple.		02	06.65		41	33.44	do	Do.
West Salisbury:								
Powderhouse		51	22.08		54	51.36	do	Do.
Church		50	39.64		55	01.21	do	Do.
West Scituate, church		09	28.33		51	10.23	do	Do.
Weymouth Great Hill		14	59.38		56	33.50	do	Do.
White		07	05.94		41	24.59	do	Do.
White Hill		12	52.47		58	39.30	do	Do.
Winthrop Head		22	04.07		58	06.04	do	Do.
Winthrop Head, 2		22	04.36		58	08.25	do	Do.
Wood End light-house		01	16.61		11	38.49	do	Do.
Woods Hotel		45	23.87		48	15.60	do	Do.
Woodward Hill, flag		36	59.74		42	05.96	do	Do.
	42°-43°			71°-72°				
Adams School, flagstaff	42	21	57.86	71	01	59.08	do	Do.
Agassiz Museum		22	44.52		06	56.04	do	Do.
Alum Pond		01	14.51		45	45.24	do	Do.
Ashland		16	37.41		06	52.84	do	Do.
Asnebumskit		18	05.11		53	50.81	do	Do.
Bald Hill		02	44.22		42	35.59	do	Do.
Battery Wharf		22	01.32		02	59.22	do	Do.
Bay State Iron Works		20	24.77		02	22.31	do	Do.
Bay State Steam Engine Works		21	45.52		02	09.69	do	Do.
Bell Tower		17	50.78		06	30.83	do	Do.
Bird Island		21	22.80		01	15.97	do	Do.
Beacon		21	18.06		01	15.96	do	Do.
Blind Asylum		20	07.04		02	32.86	do	Do.
Blue Hill		12	43.68		06	52.71	do	Do.
Boston:								
State prison cupola		22	28.23		04	08.84	do	Do.
Berkley street, yellow spire		20	44.13		04	15.42	do	Do.
Hanover street, brick church		21	49.90		03	17.44	do	Do.
Hollis street church		20	59.42		03	53.15	do	Do.
Jail, cupola		21	43.26		04	14.44	do	Do.
Catholic cathedral statue		20	12.67		04	25.14	do	Do.
Neck, dark spire with cross		20	26.77		04	25.27	do	Do.
St. Mary's church, north spire		21	54.82		03	29.69	do	Do.
State House		21	29.59		03	51.04	do	Do.
Boxboro		29	29.94		31	39.96	G. S	Bull. 122.
Boylston School, cupola		21	21.51		03	09.02	C. & G. S	Rept. '85.
Breed Island		23	28.04		00	30.28	do	Do.
Brick factory		23	45.12		04	12.89	do	Do.
Near Mystic River, cupola		24	32.76		05	27.07	do	Do.
Brighton:								
East church		20	57.83		09	13.03	do	Do.
West church, with clock		20	56.25		09	20.29	do	Do.
Brookline, Dr. Pierce's church		19	38.18		07	52.48	do	Do.
Brown Hill		37	00.54		50	41.31	G. S	Bull. 122.
Bunker Hill:								
Catholic church		22	53.34		04	00.70	C. & G. S	Rept. '85.
Monument		22	35.05		03	40.56	do	Do.
Burnt Swamp		01	08.36		22	54.53	do	Do.
Cambridge.								
Baptist church		22	34.42		07	07.71	do	Do.
Gas works chimney		22	24.35		07	36.78	do	Do.
Observatory, center of dome		22	53.49		07	43.88	do	Do.
Observatory, meridian mark		25	47.43		07	43.52	do	Do.
Observatory, west transit		22	53.48		07	44.48	do	Do.
Unitarian church		22	28.70		07	10.78	do	Do.
Cambridgeport:								
Flagstaff near engine house		21	45.58		05	15.64	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
	°	'	"	°	'	"		
Cambridgeport—Continued.								
Observatory dome	42	21	19.06	71	06	35.85	C. & G. S	Rept. '85.
Redoubt, flagstaff		21	23.89		06	17.21	do	Do.
Universalist church		21	47.52		06	00.88	do	Do.
Captain John's Hill		16	15.67		07	47.00	do	Do.
Carpet-cleaning factory		21	16.62		04	39.93	do	Do.
Castle Island		20	19.26		00	45.65	do	Do.
Center		21	09.74		02	46.38	do	Do.
Central Wharf cupola		21	32.54		03	05.21	do	Do.
Chelsea:								
Bridge		22	56.55		02	55.67	do	Do.
Brown tower		23	28.98		01	46.40	do	Do.
Church		24	32.98		00	26.28	do	Do.
Dark spire cross		23	40.47		01	54.68	do	Do.
Tall dark spire		23	30.56		02	16.90	do	Do.
White spire, martin hole windows		23	24.55		02	19.91	do	Do.
White spire, three tiers windows		23	36.20		02	16.13	do	Do.
White spire, with clock		23	27.33		02	18.18	do	Do.
Chandler Hill		16	15.20		47	11.43	do	Do.
Charles River tripod		21	09.41		07	00.28	do	Do.
Charlestown, brick church cross		22	21.96		03	48.32	do	Do.
Cloverdon		22	47.54		07	18.42	do	Do.
Observatory (zenith telescope)		22	46.29		07	17.60	do	Do.
Coal shed, flagstaff		23	06.56		02	39.20	do	Do.
Commercial Point, wharf, flag		18	00.28		02	38.24	do	Do.
Corey		20	33.38		08	02.20	do	Do.
Cunard Wharf, flagstaff		21	49.98		02	27.98	do	Do.
Dorchester:								
Church, with clock		18	29.60		03	45.81	do	Do.
Dr. Codman's church		17	26.85		04	18.00	do	Do.
Heights		20	03.43		02	35.91	do	Do.
East Boston		22	53.13		02	11.74	do	Do.
Brick church, dark spire		22	26.77		02	21.89	do	Do.
Dry dock, post		21	44.76		01	54.81	do	Do.
Elevator		21	47.59		02	15.51	do	Do.
Granite church, dark spire		22	16.06		02	28.44	do	Do.
Iron works, chimney		22	55.76		01	48.44	do	Do.
Point, flag		21	58.24		01	44.75	do	Do.
Reservoir, 2		22	52.56		02	09.91	do	Do.
Shipyard, east wharf, post		21	50.12		01	41.59	do	Do.
Eastern avenue, wharf, post		21	50.10		02	56.18	do	Do.
East Cambridge:								
Church near court-house		22	11.46		04	50.78	do	Do.
Court-house, cupola		22	11.95		04	48.56	do	Do.
Edgeworth Mills (round chimney)		25	01.38		04	30.87	do	Do.
Faneuil Hall		21	36.38		03	23.70	do	Do.
Farm schoolhouse, southeast gable		19	05.26		00	27.55	do	Do.
Fay Mountain		14	23.79		37	42.54	G. S.	Bull. 122.
Fitchburg:								
Depot		22	00.36		03	41.64	C. & G. S.	Rept. '85.
Roundhouse		22	23.43		04	10.02	do	Do.
Flagstaff, corner Dorchester street and turnpike.		19	47.62		03	26.50	do	Do.
Forbes		15	27.87		01	38.94	do	Do.
Fort Hill, wharf, post		21	15.74		03	05.16	do	Do.
Fort Independence, flagstaff		20	18.90		00	44.92	do	Do.
Foster Wharf, post		21	21.15		03	01.36	do	Do.
Foxboro:								
Baptist church, white spire		03	51.18		15	05.06	do	Do.
Orthodox church, dark spire		03	54.65		15	08.34	do	Do.
Fulton Wire Works, south chimney		20	08.04		03	29.56	do	Do.
Gambrel, roof, northeast gable		22	18.38		03	26.45		
Gas works:							do	Do.
Near Malden Bridge		23	18.75		04	29.70	do	Do.
North end of Boston		22	01.90		03	28.38	do	Do.
Ventilator		20	50.28		03	27.18	do	Do.
Glass works, east gable		22	22.65		04	41.86	do	Do.
Governors Island		21	08.31		00	39.03	do	Do.
Governors Island, 2		21	09.10		00	42.86	do	Do.
Governors Island, 3		21	08.84		00	41.12	do	Do.
Grand Junction, wharf		21	47.39		02	22.93	do	Do.
Grays Wharf, long brick building		22	09.48		03	16.38	do	Do.
Groton Hill		36	38.28		33	28.31	G. S.	Bull. 122.
Guide post, west end of milldam		20	55.63		05	51.00	C. & G. S	Rept. '85.
High service		19	31.35		05	42.30	do	Do.
Hog Island tripod		23	30.16		00	39.69	do	Do.
Holmes factory		22	45.76		03	29.36	do	Do.
Holt		38	28.03		06	24.87	do	Do.
House on hill		34	51.96		59	02.35	G. S	Bull. 122.
Hyde Park Catholic church		15	18.56		07	23.15	C. & G. S	Do.
India wharf:								
Cupola		21	29.10		02	59.70	do	Rept. '85.
Post		21	28.04		02	59.09	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
	°	′	″	°	′	″		
Iron smokestack	42	23	14.06	71	02	26.10	C. & G. S	Rept. '85.
James and Pope's timber dock		20	32.51		02	39.68	do	Do.
Jerusalem		15	20.73		08	49.00	do	Do.
Jewish cemetery		15	35.37		09	15.07	do	Do.
Joe Rock		01	52.99		24	17.24	do	Do.
Lawrence School, cupola		20	28.78		03	12.88	do	Do.
Lewis Wharf, cupola		21	47.44		03	00.02	do	Do.
Lincoln Wharf, post		21	57.72		02	58.15	do	Do.
Long Wharf		21	37.65		02	53.75	do	Do.
Building, lightning rod		21	37.08		02	57.46	do	Do.
2, post		21	36.45		02	53.54	do	Do.
Loring's machine-shop wharf		20	31.60		02	02.70	do	Do.
Lowell:								
Depot, flagstaff		21	53.81		03	47.12	do	Do.
Draw, flagstaff		22	05.14		04	08.40	do	Do.
Roundhouse		22	09.74		04	23.39	do	Do.
Machine shop, tall chimney, on ridgepole.		20	28.60		03	59.10	do	Do.
Malden:								
Bridge		23	11.41		04	13.50	do	Do.
Bridge, yellow house, chimney at tall gable.		23	34.58		04	09.58	do	Do.
Church, tall spire		25	38.84		04	01.56	do	Do.
Yellow spire		25	38.75		04	01.44	do	Do.
Mansfield, old Unitarian Church		01	23.43		13	04.03	do	Do.
Marine Hospital, flagstaff		23	21.22		02	43.70	do	Do.
Massachusetts north base		03	06.59		12	24.87	do	Do.
McLean Asylum, north dome		22	37.26		04	54.68	do	Do.
Medford:								
Tall square chimney near Malden bridge.		24	52.20		06	31.54	do	Do.
Unitarian church		25	13.97		06	56.23	do	Do.
Milldam:								
Regatta house flagstaff		21	04.89		05	19.01	do	Do.
Yellow house, chimney		20	56.22		05	51.67	do	Do.
Miller River, head of church		22	44.08		05	48.79	do	Do.
Milton:								
Church		15	12.35		04	50.38	do	Do.
Old church		15	12.35		04	50.38	do	Do.
Mills, tall church spire		16	26.49		04	07.96	do	Do.
Mount Auburn		22	10.94		08	40.37	do	Do.
Mount Daniel		01	41.54		48	10.30	do	Do.
Mugget		08	02.12		57	26.24	do	Do.
National dock building		22	02.92		02	33.56	do	Do.
Naval Hospital		23	22.58		02	55.94	do	Do.
Navy-Yard:								
Battery		22	23.97		03	06.32	do	Do.
Chimney		22	30.04		03	09.16	do	Do.
Nealys House		21	22.37		06	27.13	do	Do.
Neponset church		17	11.62		07	52.87	do	Do.
New England Glass Company, chimney.		22	21.35		04	40.31	do	Do.
North Brighton, dark spire		21	13.69		08	12.35	do	Do.
Northeast corner of Connecticut		01	24.82		48	04.20	do	Do.
Northwest corner of Rhode Island		00	29.15		47	58.92	do	Do.
Observatory		25	53.23		37	37.19	G. S	Bull. 122,
Octagonal building		21	37.37		04	19.02	C. & G. S	Rept. '85.
One-story red building		22	07.93		04	17.38	do	Do.
Organ factory		21	44.45		04	58.17	do	Do.
Outer Brewster		20	29.40		52	41.16	do	Do.
Otter street		21	21.48		04	24.90	do	Do.
Peck's chimney		22	51.09		03	03.64	do	Do.
Pepperell		42	12.64		35	12.59	do	Do.
Petty Rock		16	16.05		06	49.62	do	Do.
Planing mill, chimney		22	16.17		07	17.17	do	Do.
Point Curve		21	14.02		02	56.28	do	Do.
Poplar Hill, stone monument		44	11.56		15	20.30	do	Do.
Powderhorn		24	04.68		01	52.01	do	Do.
Powderhorn, 2		24	04.56		01	52.05	do	Do.
Powers and Melville's elevator		22	59.03		04	40.01	do	Do.
Prentice coal wharf, post		21	08.76		03	11.58	do	Do.
Prospect:								
Somerville		22	54.62		05	37.88	do	Do.
Waltham		23	18.83		15	15.33	do	Do.
Quincy, stone church		15	04.25		00	12.98	do	Do.
Red Brush		01	49.55		22	23.46	do	Do.
Reservoir		20	47.50		34	05.96	G. S	Bull. 122.
Riverside Press, chimney		21	46.03		06	57.05	C. & G. S	Rept. '85.
Roxbury:								
Dr. Putnam's church		19	47.81		05	24.96	do	Do.
Laboratory, chimney		19	24.52		05	52.98	do	Do.
Tall spire in Jamaica Plains		18	36.44		06	59.36	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			71°-72°				
Roxbury—Continued.	°	′	″	°	′	″		
New Unitarian church	42	19	42.11	71	04	51.72	C. & G. S	Rept. '85.
Oil works, chimney		19	55.40		03	55.14	do	Do.
Sailors' Home, cupola		21	19.10		03	08.40	do	Do.
Sargent's Observatory		18	42.75		05	41.40	do	Do.
South Bay, tripod		19	31.09		03	46.58	do	Do.
Somerville:								
Church near Malden bridge		23	07.43		04	36.63	do	Do.
Church on hill		23	12.18		05	52.37	do	Do.
Red church		23	11.98		05	52.46	do	Do.
South Boston:								
Dark spire, cross		20	31.87		03	24.44	do	Do.
Point		20	13.02		01	33.45	do	Do.
Reservoir		19	58.48		02	46.56	do	Do.
Sea wall		21	18.40		02	43.48	do	Do.
Squantum		18	13.89		00	41.57	do	Do.
Standard sugar refinery		20	44.00		03	15.58	do	Do.
Stone powder house		24	00.40		07	00.17	do	Do.
Suffolk cordage factory, ball		19	38.04		04	20.24	do	Do.
Sumner		15	21.05		09	32.22	do	Do.
Ten Hill farm, flag		23	50.88		05	15.26	do	Do.
Thompson Island:								
Flag		19	14.60		00	16.12	do	Do.
Pole near farm school		19	07.56		00	26.01	do	Do.
Town Hill		38	15.54		59	05.39	G. S	Bull. 122.
Tudor, cupola		22	14.98		03	39.81	C. & G. S	Rept. '85.
Tuft College		24	26.84		07	13.85	do	Do.
Turkey Hill		35	28.03		42	41.63	G. S	Bull. 122.
Varnish factory, chimney		21	49.54		07	06.33	C. & G. S	Rept. '85.
Wachusett:								
Chimney		29	21.28		53	15.13	G. S	Bull. 122.
C. & G. S. station		29	20.78		53	13.98	do	Do.
Waite, 1		26	00.83		03	57.96	C. & G. S	Rept. '85.
Waite, 2		26	20.43		01	13.14	do	Do.
Watertown Arsenal		21	42.72		09	45.97	do	Do.
Watatick:								
C. & G. S. station		41	48.55		53	34.87	G. S	Bull. 122.
State line		42	40.93		53	55.73	C. & G. S	Rept. '85.
Tree		41	48.47		53	34.40	G. S	Bull. 122.
Waverly House		22	17.56		03	46.42	C. & G. S	Rept. '85.
Wellington Hill		16	59.24		05	44.08	do	Do.
West Boston bridge, pole on draw		21	41.49		04	26.12	do	Do.
West Cambridge, tall spire with clock		24	55.63		09	15.82	do	Do.
Winnisimet, church with clock		23	27.35		02	18.18	do	Do.
Winslow's factory, corner		23	02.22		03	53.96	do	Do.
	42°-43°			72°-73°				
Amherst	42	22	15.30	72	31	07.00	do	Do.
Agricultural College belfry		23	26.31		31	46.50	do	Do.
Agricultural College drill-hall tower.		23	17.06		31	43.56	do	Do.
Agricultural College flagstaff		23	21.69		31	42.64	do	Do.
City, Methodist church tower		24	50.34		30	32.79	do	Do.
College Hall		22	22.02		31	14.42	do	Do.
Congregational church spire		22	32.07		31	00.60	do	Do.
Episcopal church spire		22	29.76		31	09.06	do	Do.
Lawrence Observatory		22	17.06		31	10.05	do	Do.
Walker Hall tower		22	18.21		31	02.82	do	Do.
Williston Hall tower		22	17.76		31	06.59	do	Do.
Battlecock		23	02.70		46	25.40	do	Do.
Belchertown:								
Baptist church tower		16	40.81		24	04.66	do	Do.
First Congregational church spire.		16	42.68		24	05.98	do	Do.
High School tower		16	37.90		24	11.95	do	Do.
Methodist church tower		16	42.12		24	10.26	do	Do.
Boundary Rock		01	53.84		16	18.42	do	Do.
Brush		09	03.89		39	39.62	do	Do.
Chestnut Hill		24	34.30		39	40.10	do	Do.
Chicopee:								
French Catholic church spire		08	49.11		35	34.15	do	Do.
Catholic church spire		08	40.28		36	20.25	do	Do.
Skating rink spire		08	50.25		36	36.77	do	Do.
Chicopee Falls:								
Congregational spire		09	25.06		34	51.70	do	Do.
Catholic church spire		09	42.82		34	51.06	do	Do.
Methodist church spire		09	25.50		35	00.37	do	Do.
New Baptist church spire		09	26.08		34	54.10	do	Do.
Town Hall spire		08	54 65		36	25.94	do	Do.
Colonel Mountain		14	09.35		13	58.35	do	Do.
Connecticut line, signal (Borden)		01	55.98		20	46.14	do	Do.
Connecticut River Lumber Co., chimney.		17	29.65		37	14.30	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			72°-73°				
	°	′	″	°	′	″		
Conway Township, southeast corner	42	27	30.25	72	39	28.34	C. & G. S	Rept. '85.
Craft		12	46.51		38	20.46	do	Do.
Dickinson, flag in tree		25	31.50		30	26.60	do	Do.
Dolbar Hill		32	45.62		03	30.40	G. S	Bull. 122.
East bench mark		12	53.96		36	10.22	C. & G. S	Rept. '85.
Easthampton:								
First Congregational church spire.		16	20.74		40	17.24	do	Do.
Methodist church spire		16	15.79		40	22.28	do	Do.
Payson Congregational church spire.		16	12.02		40	22.78	do	Do.
Williston, Knight & Co., chimney		16	00.90		40	11.40	do	Do.
Williston Mills, tower		16	27.69		39	33.42	do	Do.
Williston Seminary gymnasium, tower.		16	13.85		40	16.00	do	Do.
Town Hall, tower		16	16.66		40	21.85	do	Do.
East Longmeadow, Congregational spire.		03	51.49		30	45.62	do	Do.
East tidal bench mark		12	53.95		36	10.40	do	Do.
Facing Rock		13	08.84		27	35.00	do	Do.
Feeding Hills		03	52.20		40	53.75	do	Do.
Congregational spire		04	04.15		40	45.48	do	Do.
Methodist spire		03	58.94		40	44.54	do	Do.
Florence:								
Methodist church spire		20	07.10		40	25.20	do	Do.
Engine-house tower		20	04.50		40	19.40	do	Do.
Catholic church spire		19	56.78		40	07.03	do	Do.
Congregational church spire		19	54.16		40	30.00	do	Do.
Manufacturing Co.'s mill, tower		19	53.57		40	44.64	do	Do.
School-house tower		19	51.98		40	33.41	do	Do.
Granby, Congregational church spire		15	22.87		31	04.12	do	Do.
Hadley:								
First Congregational church spire		20	30.88		35	20.81	do	Do.
Second Congregational church spire.		20	33.90		35	47.72	do	Do.
Hatchet		01	39.60		04	46.74	do	Do.
Hatfield:							do	Do.
Congregational church spire		22	13.68		35	50.97	do	Do.
Smith Academy, tower		22	15.68		35	44.70	do	Do.
Hawes Hill		27	26.43		07	07.18	do	Do.
Haydensville:								
Catholic church spire		22	22.87		41	53.70	do	Do.
Congregational church spire		21	15.34		41	39.08	do	Do.
High Ridge Hill		26	55.14		43	06.66	do	Do.
Hilliard Knob		18	20.23		30	38.37	do	Do.
Hitchcock		05	07.39		15	35.43	do	Do.
Holland House, chimney		05	05.04		42	14.89	do	Do.
Holyoke:								
City Hall tower		12	24.32		30	28.10	do	Do.
Engine-house tower		12	46.50		37	31.98	do	Do.
First Congregational belfry		12	41.16		37	49.36	do	Do.
Windsor Hotel tower		12	23.07		36	22.72	do	Do.
St. Jerome's Catholic spire		12	34.10		36	31.76	do	Do.
Second Baptist tower		12	24.78		36	48.58	do	Do.
Second Congregational tower		12	18.36		36	39.50	do	Do.
Indian Orchard, church spire		09	32.02		30	07.04	do	Do.
Jenksville, church tower		09	31.91		29	06.70	do	Do.
Jenksville, church tower, 2		09	30.19		28	58.94	do	Do.
Ludlow, Methodist tower		11	29.10		27	09.72	do	Do.
Leverett, Congregational church spire.		27	07.80		30	06.90	do	Do.
Longmeadow, Congregational church spire.		03	00.83		34	56.24	do	Do.
McCarthy		04	13.05		30	17.18	do	Do.
Mount Esther		27	10.19		39	54.64	do	Do.
Mount Holyoke Hotel, flagstaff		18	02.10		35	17.70	do	Do.
Mount Lincoln		21	49.38		25	24.53	do	Do.
Mount Toby		29	16.32		32	16.28	do	Do.
Mount Tom		14	30.80		38	55.06	do	Do.
Mount Warner		22	48.40		34	22.20	do	Do.
New Braintree, Congregational church spire		19	01.16		07	35.90	do	Do.
Nonotuck Hotel, tower		16	47.86		37	15.20	do	Do.
North Amherst, Congregational church spire.		24	36.74		31	52.29	do	Do.
North Base		28	46.15		36	43.57	do	Do.
North Hadley, Congregational church spire.		23	19.70		34	52.10	do	Do.
Northampton:								
Lunatic Asylum tower		18	52.16		38	51.00	do	Do.
Catholic church tower		19	38.61		38	02.98	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			72°-73°				
	°	′	″	°	′	″		
Northampton—Continued.								
Episcopal church tower	42	19	16.38	72	37	42.57	C. & G. S	Rept. '85.
First Congregational church spire		19	09.25		37	53.14	do	Do.
Methodist church spire		19	10.72		37	59.58	do	Do.
Round Hill flagstaff		19	27.53		38	22.38	do	Do.
Second Congregational church spire.		19	04.62		38	04.32	do	Do.
North Warner		22	56.00		34	17.90	do	Do.
Packard		27	40.64		21	11.09	do	Do.
Palmer, Universalist church spire		09	28.06		19	35.91	do	Do.
Peaked Mountain		02	50.94		20	26.20	do	Do.
Pelham, church spire		23	32.30		24	17.34	do	Do.
Rattle, flag in tree		01	59.08		24	28.67	do	Do.
Rattlesnake		01	59.58		24	28.60	do	Do.
Rock Rimmon		14	23.14		26	29.07	do	Do.
Secondary signal		02	23.04		54	07.82	do	Do.
Shingle Hill		23	23.30		41	59.50	do	Do.
Shutesbury:								
Congregational church spire		27	11.85		24	37.34	do	Do.
Baptist church spire		27	10.31		24	36.46	do	Do.
House, chimney		27	42.20		24	41.61	do	Do.
South Amherst, church spire		20	25.45		30	13.94	do	Do.
South Deerfield, Congregational church spire.		28	44.71		36	27.16	do	Do.
South Hadley, Congregational church spire.		15	31.59		34	31.26	do	Do.
South Hadley Falls:								
Catholic church spire		13	13.03		36	05.58	do	Do.
Congregational church spire		12	58.25		35	56.56	do	Do.
Methodist church spire		13	00.92		35	56.42	do	Do.
Female Seminary Observatory		15	21.78		34	40.88	do	Do.
Springfield:								
Arsenal, clock tower		06	26.48		34	54.70	do	Do.
Court-house tower		06	01.48		35	21.02	do	Do.
First Baptist church spire		06	10.88		35	04.19	do	Do.
Florence Street Methodist church spire.		06	01.11		34	03.72	do	Do.
Hope Congregational church tower.		06	38.69		33	55.63	do	Do.
North Congregational church spire.		06	21.77		35	13.45	do	Do.
St. Joseph's Catholic church spire		06	06.63		35	10.64	do	Do.
South Congregational church spire.		06	08.04		35	00.10	do	Do.
St. Michael's church spire		06	15.20		35	05.10	do	Do.
State Street Methodist church spire.		06	19.18		34	53.36	do	Do.
Water-shops tower		05	51.94		33	50.44	do	Do.
Sugarloaf Hotel:								
South chimney		28	13.00		35	32.98	do	Do.
North chimney		28	13.30		35	33.08	do	Do.
Sunderland:								
Schoolhouse tower		28	02.32		34	44.74	do	Do.
Congregational church tower		27	57.91		34	49.70	do	Do.
Three Rivers, French Catholic church spire.		11	00.72		21	21.30	do	Do.
Tuft Hill		19	01.54		05	04.56	do	Do.
Two Tree		39	10.99		08	40.19	G. S	Bull. 122.
Ward Hill		34	12.13		10	24.85	do	Do.
Warwick (Borden)		43	21.57		19	14.26	C. & G. S	Rept. '85.
West bench mark		12	44.22		36	14.10	do	Do.
West Hampton, Congregational church spire.		18	16.57		46	32.39	do	Do.
West Springfield, First Congregational church spire.		06	52.18		37	31.94	do	Do.
Whately Congregational church spire		26	17.10		38	07.40	do	Do.
White, flag in tree		12	02.27		29	47.53	do	Do.
Wigwam		06	26.00		24	45.10	do	Do.
Wilbraham:								
Congregational church spire		07	16.48		25	54.87	do	Do.
Rich Hall, tower		07	27.68		25	55.10	do	Do.
	42°-43°			73°-74°				
Alander Mountain	42	05	15.06	73	30	18.72	do	Do.
Bald Peak		06	07.30		25	59.11	do	Do.
Brace Mountain		02	39.91		29	34.88	do	Do.
Corner stone, southwest corner of State.		02	58.38		29	15.96	do	Do.
Dome Peak		06	07.30		25	59.11	do	Do.
French Hill		25	38.46		02	16.44	do	Do.
Greylock		38	14.09		09	59.13	do	Do.
Iron Bolt		02	58.67		29	42.62	do	Do.
Perry Peak		25	15.65		22	48.78	do	Bull. 122.

MASSACHUSETTS—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	73°-74°		
	° ′ ″	° ′ ″		
Ryant Bush	42 03 04.05	73 28 56.63	C. & G. S	Bull. 122.
Washington spire	21 57.78	08 39.78	do	Do.
	41°-42°	69°-70°		
Basin	41 39 48.50	69 56 41.66	do	Rept. '85.
Camp	43 59.58	59 33.25	do	Do.
Chatham	41 50.70	58 48.38	do	Do.
Congregational church spire	40 58.54	57 41.72	do	Do.
Flagstaff	40 43.77	57 23.51	do	Do.
North light-house	40 18.28	57 01.27	do	Do.
South light-house	40 17.30	57 01.50	do	Do.
Spire	41 02.79	57 39.96	do	Do.
Cove	36 56.18	58 35.17	do	Do.
Crows Lookout	43 06.96	58 25.46	do	Do.
Cumming flagstaff	47 12.17	57 04.36	do	Do.
Eastham, Congregational church spire.	50 28.28	58 54.33	do	Do.
Eldridge	44 34.88	58 39.69	do	Do.
Harding Beach	39 31.55	59 03.16	do	Do.
Lombard Head	55 51.66	58 51.02	do	Do.
Marsh	43 51.92	55 39.55	do	Do.
Mayo	46 00.17	57 10.44	do	Do.
Monomoy	35 37.60	59 03.36	do	Do.
Light-house	33 33.78	59 39.02	do	Do.
Morris Island	39 29.48	57 34.14	do	Do.
Mosquito	39 26.91	57 32.60	do	Do.
Namequoit	45 26.74	57 42.48	do	Do.
Nauset:				
Beach	44 05.66	55 34.32	do	Do.
Center light-house	51 38.63	57 05.42	do	Do.
Harbor	47 22.72	56 46.80	do	Do.
Old Harbor	42 19.94	59 01.11	do	Do.
Orleans, Orthodox church spire	47 04.86	58 30.20	do	Do.
Pine	40 08.56	59 35.48	do	Do.
Pleasant Bay	44 34.89	58 39.64	do	Do.
Pochet	46 39.98	56 26.09	do	Do.
Sampson	45 21.74	57 00.43	do	Do.
Sankaty Head	16 59.91	57 53.41	do	Do.
Sankaty Head light-house	17 01.21	57 56.52	do	Do.
Shells	57 52.80	57 41.45	do	Do.
Sipson Island	44 09.28	57 52.03	do	Do.
South Wellfleet:				
Congregational church belfry	54 32.07	59 07.10	do	Do.
Methodist meetinghouse	54 24.54	59 07.72	do	Do.
Squam Head	19 33.48	59 56.05	do	Do.
Stage Harbor light-house	39 31.55	59 03.16	do	Do.
Strong	43 12.48	57 29.61	do	Do.
	41°-42°	70°-71°		
Aldin	41 49 48.33	70 57 02.79	do	Do.
Angelica Point	38 28.97	45 55.35	do	Do.
Atwood	45 11.39	04 24.31	do	Do.
Back River Harbor	43 18.58	36 50.49	do	Do.
Barnstable	41 48.82	18 25.58	do	Do.
West spire	41 54.89	23 03.28	do	Do.
Court-house	42 06.02	18 17.64	do	Do.
Light-house	43 21.16	16 53.34	do	Do.
Unitarian spire	42 02.46	17 57.67	do	Do.
Bass Hole	42 49.98	14 15.54	do	Do.
Bass River	38 38.44	12 12.13	do	Do.
Light-house	39 06.44	10 10.84	do	Do.
Billingsgate light-house	52 18.22	04 09.87	do	Do.
Bird Island light-house	40 09.65	43 04.14	do	Do.
Bishop and Clerks	34 27.44	15 01.96	do	Do.
Light-house	34 27.52	15 02.04	do	Do.
Blackfish Creek	54 28.86	01 04.80	do	Do.
Bluff (Nantucket)	17 31.40	06 26.77	do	Do.
Bourne Hill	44 00.82	29 11.63	do	Do.
Bowman Hill observatory	32 38.10	36 04.32	do	Do.
Bowman Point	32 36.46	36 05.84	do	Do.
Brant Point light-house	17 23.20	05 34.61	do	Do.
Brewster	46 12.76	04 46.46	do	Do.
Unitarian church spire	45 43.24	04 57.32	do	Do.
Cambria	59 14.88	00 45.13	do	Do.
Cape Poge	25 11.50	27 03.75	do	Do.
Light-house	25 16.03	27 05.70	do	Do.
Centerville church	38 44.94	20 49.27	do	Do.
Charles Neck	40 21.61	44 45.04	do	Do.
Clark Cove	15 20.47	10 43.16	do	Do.
Clark Point	35 34.15	54 03.69	do	Do.
Light-house	35 34.28	54 03.91	do	Do.
Coatue Point	19 06.62	02 57.07	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42° ° ′ ″	70°-71° ° ′ ″		
Coatue Point, 2	41 18 05.39	70 04 39.87	C. & G. S	Rept. '85.
Collier Ledge	35 48.36	21 06.69	do	Do.
Cotuit Neck	35 31.16	26 44.25	do	Do.
Cromeset Neck	43 41.74	43 20.57	do	Do.
Cuttyhunk	25 14.89	56 02.65	do	Do.
Light-house	24 52.36	57 00.18	do	Do.
Davis Hill	31 24.30	39 39.24	do	Do.
Davis Neck	32 54.42	33 48.63	do	Do.
Desert Hill	29 28.73	44 21.35	do	Do.
Dumpling Rock (Round Hill) light-house.	32 17.88	55 19.09	do	Do.
Duxbury Pier light-house	59 14.94	38 56.57	do	Do.
East Chop	28 04.80	33 50.91	do	Do.
Telegraph	28 04.72	33 49.00	do	Do.
Light-house	28 13.44	34 04.96	do	Do.
East Chop, 2	28 04.63	33 50.90	do	Do.
East Scargo (Borden)	44 00.87	10 16.39	do	Do.
East Plymouth	52 58.09	32 01.74	do	Do.
Eastham	49 26.09	00 14.92	do	Do.
Edgartown	23 51.77	32 55.96	do	Do.
Light-house	23 27.29	30 12.76	do	Do.
Spire	23 18.64	30 55.88	do	Do.
Eel River, steeple	56 15.18	37 49.12	do	Do.
Fair Haven, black spire	38 09.81	54 18.85	do	Do.
Falmouth	35 53.11	37 05.48	do	Do.
Spire	33 14.95	37 12.52	do	Do.
Fish-house, north gable	38 19.40	10 38.15	do	Do.
Folger, astronomic station	17 16.94	06 16.56	do	Do.
Forked Pond	14 15.94	01 03.65	do	Do.
Further Creek	16 39.72	14 06.85	do	Do.
Gay Head	20 50.30	50 13.96	do	Do.
Light-house	20 54.59	50 07.58	do	Do.
German Hill	41 27.96	12 35.98	do	Do.
Gibb Pond	16 53.65	01 31.46	do	Do.
Great Hill	42 33.28	43 20.44	do	Do.
Great Point (Nantucket) light-house	23 24.34	02 46.06	do	Do.
Great Rock, spindle	37 03.52	17 10.38	do	Do.
Griffin Island	56 14.37	04 06.05	do	Do.
Hamblin Hill	41 49.93	24 13.64	do	Do.
Hamblin Mound	56 14.18	02 47.46	do	Do.
Harwich belfry	41 12.39	04 35.97	do	Do.
Harwich Port	39 51.30	04 06.57	do	Do.
Herring Pond	20 47.35	31 34.16	do	Do.
Highland House, north tower	27 50.26	33 36.17	do	Do.
Hog Island Harbor	36 15.84	38 57.00	do	Do.
Holmes	55 26.56	32 39.02	do	Do.
Holmes Hole (or West Chop) light-house.	28 51.06	36 00.96	do	Do.
Holmes Hole	28 57.66	36 10.78	do	Do.
Holmes Hole, spire	27 15.15	36 20.18	do	Do.
Hopkins	46 02.05	02 51.54	do	Do.
Hyannis	37 53.34	18 26.67	do	Do.
West spire	39 05.77	17 15.21	do	Do.
Light-house	38 10.79	17 20.20	do	Do.
Universalist spire	39 14.38	16 56.08	do	Do.
Indian	25 46.74	40 40.70	do	Do.
Brook	51 30.36	00 23.41	do	Do.
Hill	52 58.13	32 01.75	do	Do.
Neck	43 33.27	41 27.05	do	Do.
Kingston	58 53.29	41 54.63	do	Do.
Kingston spire	59 36.08	43 52.77	do	Do.
Kotayma House, north tower	21 30.10	30 19.67	do	Do.
Long Neck	44 20.21	38 45.42	do	Do.
Mannerson	41 31.14	12 16.86	do	Do.
Manomet	55 38.70	35 28.13	do	Do.
Marston Mill	38 49.68	24 56.98	do	Do.
Mattapoisett, gray spire	39 43.93	49 12.28	do	Do.
Mattapoisett Neck	37 46.57	48 11.30	do	Do.
Mayo Beach light-house	55 49.82	02 05.66	do	Do.
Menauhant Hotel, west chimney	33 01.00	33 09.76	do	Do.
Menauhant Landing, flagstaff	32 59.68	33 08.92	do	Do.
Mendal (Borden)	42 03.03	53 00.02	do	Do.
Mill Hill	46 34.14	00 06.97	do	Do.
Mishaum Point	30 56.11	57 16.44	do	Do.
Monaunt Hill	33 05.51	32 32.48	do	Do.
Monks Hill	57 39.11	43 23.40	do	Do.
Monument church	44 32.45	35 49.73	do	Do.
Muskeget Island	20 14.11	17 58.47	do	Do.
Nantucket:				
Baptist church	16 52.66	06 07.00	do	Do.
Great Point light-house	23 24.34	02 46.06	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			70°-71°				
et—Continued.	°	′	″	°	′	″		
h towered church	41	17	09.94	70	06	08.22	C. & G. S.	Rept. '85.
Range beacon (rear)		17	35.55		06	25.10	do	Do.
		17	35.81		06	53.79	do	Do.
h towered Unitarian church		16	56.72		05	58.09	do	Do.
e beacon		16	23.92		04	42.86	do	Do.
itsa Cliff		20	00.34		44	27.30	do	Do.
na		25	30.97		52	06.61	do	Do.
		29	25.03		44	33.38	do	Do.
hwest		27	01.82		47	19.97	do	Do.
heast		30	35.72		42	48.91	do	Do.
t light-house		39	03.34		47	46.11	do	Do.
lford:								
t-house		38	03.72		55	52.96	do	Do.
ist church		38	12.37		55	36.98	do	Do.
on		36	33.62		53	28.73	do	Do.
		37	27.06		54	10.37	do	Do.
mouth		33	42.42		37	52.42	do	Do.
Point light-house		30	57.24		39	20.20	do	Do.
s Land		15	11.70		48	49.20	do	Do.
ennis		44	42.24		12	29.82	do	Do.
spire		44	14.85		11	32.53	do	Do.
e spire		44	13.77		11	35.41	do	Do.
ennis, 2		43	29.20		12	04.70	do	Do.
almouth, spire		38	33.32		37	07.29	do	Do.
ymouth Rope Works		58	47.50		41	20.16	do	Do.
ond		17	38.41		10	32.15	do	Do.
ellfleet:								
odist belfry		56	19.66		01	48.95	do	Do.
regational belfry		56	09.64		01	16.48	do	Do.
		47	32.47		00	51.46	do	Do.
2		47	32.59		00	51.63	do	Do.
e		37	52.16		22	57.14	do	Do.
		37	42.08		23	09.29	do	Do.
e Point		37	02.13		22	10.70	do	Do.
am		35	39.27		56	35.73	do	Do.
spire		35	20.12		56	28.07	do	Do.
sland light-house		37	37.27		54	34.72	do	Do.
t River		31	41.30		59	30.99	do	Do.
		26	57.82		50	04.43	do	Do.
liff		48	31.38		32	25.06	do	Do.
		26	58.17		55	26.91	do	Do.
ill		50	58.24		59	44.57	do	Do.
		42	31.13		33	58.61	do	Do.
h		57	24.78		40	07.93	do	Do.
nal monument		57	36.69		40	34.87	do	Do.
head		58	46.50		39	13.38	do	Do.
t-house		57	26.37		40	02.23	do	Do.
		49	40.62		32	37.24	do	Do.
, spire		41	41.55		36	18.28	do	Do.
mmon		37	04.96		15	39.32	do	Do.
mmon, 2		37	04.96		15	39.32	do	Do.
mmon light-house		36	35.00		16	00.19	do	Do.
Chilmark		21	56.84		44	51.05	do	Do.
House, cupola flagstaff		26	41.34		34	45.39	do	Do.
int		46	12.95		04	46.02	do	Do.
ill		32	24.79		55	50.59	do	Do.
ill (Dumpling Rock), light-		32	17.88		55	19.09	do	Do.
(Marthas Vineyard)		22	41.51		29	02.66	do	Do.
h, Orthodox church		45	28.35		30	00.45	do	Do.
		44	22.48		10	49.82	do	Do.
		45	25.10		30	49.98	do	Do.
t Neck		35	02.65		51	20.39	do	Do.
Hill		43	17.26		23	41.43	do	Do.
Neck		44	19.13		24	41.19	do	Do.
Neck		39	59.28		39	15.57	do	Do.
		44	38.30		07	57.09	do	Do.
House, north tower		27	28.54		33	23.06	do	Do.
emo		17	01.80		03	04.82	do	Do.
ng		41	07.33		20	49.74	do	Do.
church		42	09.92		45	47.88	do	Do.
Neck		40	35.93		42	58.05	do	Do.
ennis		39	06.59		08	12.40	do	Do.
h spire		40	34.25		09	24.49	do	Do.
spire		40	21.64		09	23.64	do	Do.
casset spire		40	36.28		36	22.83	do	Do.
ill Academy		44	58.86		27	36.58	do	Do.
sset		33	31.43		28	36.29	do	Do.
reek		45	32.41		08	37.40	do	Do.
l		34	02.46		38	30.70	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			70°-71°				
	°	′	″	°	′	″		
Tarpaulin Cove light-house	41	28	07.90	70	45	28.74	C. & G. S.	Rept. '85.
Tempes Knob		42	58.46		39	48.84	do	Do.
Truro, Congregational church spire		59	54.06		03	18.44	do	Do.
Tuckamuck telegraph		18	14.51		15	08.47	do	Do.
Union chapel		27	16.82		33	31.05	do	Do.
Wareham Baptist church		45	27.19		43	03.63	do	Do.
Watcha		20	52.19		36	38.35	do	Do.
Weeweeder Pond		14	35.28		05	37.92	do	Do.
Wenaumet Neck		40	58.14		39	41.00	do	Do.
West Chatham		40	09.42		01	42.19	do	Do.
West Chop		28	54.29		36	18.04	do	Do.
West Chop (Holmes Hole) light-house		28	51.06		36	00.96	do	Do.
West Chop, 2		28	52.61		35	58.26	do	Do.
West Island		34	56.62		49	20.79	do	Do.
West Island, 2		35	25.09		49	04.85	do	Do.
West Yarmouth, spire		38	59.08		13	46.73	do	Do.
Wild Harbor		38	22.19		39	09.05	do	Do.
Windmill Range		16	40.22		06	49.57	do	Do.
Wing Neck light-house		40	49.38		39	41.75	do	Do.
Wolasha Hill		20	29.02		48	38.50	do	Do.
Woods Hole		31	38.80		39	41.58	do	Do.
Episcopal church		31	19.86		39	48.10	do	Do.
Yarmouth Port, spire		42	24.82		14	37.13	do	Do.
	41°-42°			71°-72°				
Alex	41	54	07.08	71	03	34.97	do	Do.
Almy		30	42.29		01	49.85	do	Do.
Attleboro		56	54.14		17	22.60	do	Do.
Assonet		47	25.35		05	56.88	do	Do.
Spire		47	45.95		04	08.00	do	Do.
Flat-topped church, west gable chimney.		47	30.26		04	15.24	do	Do.
Bare top		48	52.85		06	00.44	do	Do.
Beacon		42	16.82		10	29.71	do	Do.
Beveled barn		50	12.73		07	09.14	do	Do.
Birch		52	08.52		05	04.66	do	Do.
Blackbeard		40	28.88		10	58.83	do	Do.
Bluff (Taunton River)		45	54.52		07	49.70	do	Do.
Bradford		54	17.32		04	38.04	do	Do.
Briggs (Taunton River)		54	56.20		03	49.46	do	Do.
Brown Hill (Taunton River)		47	25.29		06	27.65	do	Do.
Bryant Hill		49	39.79		04	43.71	do	Do.
Burns		44	26.70		08	52.72	do	Do.
Burt		51	28 72		05	49.61	do	Do.
Canonicus		53	10.26		02	47.30	do	Do.
Calvary		43	40.82		08	05.04	do	Do.
Carpenter		51	36.08		05	33.64	do	Do.
Chase		40	23.92		11	16.46	do	Do.
City		41	43.77		10	19.09	do	Do.
Clark		51	52.70		05	13.14	do	Do.
Copecut		43	17.24		03	36.64	do	Do.
Cord		53	56.12		02	36.60	do	Do.
Cupola		52	31.55		05	48.05	do	Do.
Dartmouth		34	11.59		01	47.54	do	Do.
Dean		54	37.32		04	15.35	do	Do.
Depot		46	31.09		07	15.07	do	Do.
Dodge's stable, turret		40	56.33		10	40.24	do	Do.
Durfees, cupola		42	36.36		09	04.82	do	Do.
Eddy		54	24.83		03	58.18	do	Do.
Eldridge		31	46.11		05	08.27	do	Do.
Elisha		53	58.58		02	23.21	do	Do.
Elm		53	51.72		02	17.50	do	Do.
Fall River		42	39.25		08	45.54	do	Do.
Derrick		42	19.32		09	56.72	do	Do.
Tower		42	00.87		09	25.42	do	Do.
Spire		42	06.87		09	15.00	do	Do.
Fall River, 2		42	39.74		08	45.38	do	Do.
Ferry wharf, chimney		42	34.30		10	46.90	do	Do.
Frederick		53	41.36		04	27.12	do	Do.
Florence		50	45.03		06	58.03	do	Do.
French		53	35.60		05	34.67	do	Do.
Gardner Neck		42	33.74		12	24.81	do	Do.
George		53	17.58		02	48.11	do	Do.
Globe village, chimney		41	17.27		10	23.84	do	Do.
Gooseberry Neck		29	20.08		02	19.61	do	Do.
Grave		54	04.71		02	38.62	do	Do.
Graveyard		49	34.48		07	28.94	do	Do.
Great Rock		51	32.36		17	15.47	do	Do.
Great Meadow		52	45.14		13	02.29	do	Do.
Hall		54	22.37		04	16.29	do	Do.
Hampden		53	20.15		02	23.86	do	Do.

MASSACHUSETTS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
(Taunton River)	41	53	01.44	71	05	13.98	C. & G. S.	Rept. '85.
		54	23.12		03	12.80	do	Do.
t		51	45.41		05	46.99	do	Do.
g River, spire		40	13.01		07	02.58	do	Do.
		50	57.52		06	29.89	do	Do.
Hill		57	52.71		20	52.27	do	Do.
		52	38.99		05	30.23	do	Do.
		53	11.99		02	19.21	do	Do.
n		53	20.81		04	43.52	do	Do.
dford		35	37.56		07	55.53	do	Do.
ll		53	48.39		02	27.11	do	Do.
		54	22.66		03	49.49	do	Do.
ock		45	22.82		16	17.27	do	Do.
		47	30.99		07	02.32	do	Do.
ood		53	27.74		02	12.91	do	Do.
(Taunton River)		47	38.18		07	33.80	do	Do.
		54	23.42		03	28.48	do	Do.
		54	29.24		04	11.14	do	Do.
husetts south base		54	49.92		18	16.11	do	Do.
oisett		42	40.47		12	51.76	do	Do.
w		51	11.22		06	11.96	do	Do.
		49	33.06		06	58.42	do	Do.
s		48	25.97		06	59.36	do	Do.
		32	13.02		07	25.83	do	Do.
Dighton		51	14.52		06	39.39	do	Do.
, dark-red spire		58	10.49		10	55.37	do	Do.
ll		54	51.24		16	43.23	do	Do.
rd		54	08.02		03	12.26	do	Do.
aunton River)		54	12.54		02	58.18	do	Do.
and		30	01.73		07	12.18	do	Do.
and, 2		29	56.40		07	09.16	do	Do.
ond Hill		48	27.29		07	43.35	do	Do.
		45	33.46		07	10.98	do	Do.
		51	36.08		06	17.02	do	Do.
		54	08.44		02	27.97	do	Do.
ap		53	44.16		02	12.70	do	Do.
s		53	19.88		02	35.87	do	Do.
house Hill		50	01.41		06	17.56	do	Do.
		43	41.20		10	09.12	do	Do.
et		44	07.60		10	06.49	do	Do.
tinghouse		44	11.54		10	06.89	do	Do.
re		46	17.88		07	38.87	do	Do.
et, 2		43	44.05		10	08.16	do	Do.
betty		53	20.27		02	05.70	do	Do.
ite spire		52	57.37		01	39.97	do	Do.
l factory		53	12.16		01	54.03	do	Do.
rook		44	56.97		07	23.16	do	Do.
rook, church		44	30.40		07	46.13	do	Do.
all		53	34.08		02	04.19	do	Do.
y belfry		45	03.22		13	30.90	do	Do.
ore		53	37.91		02	20.91	do	Do.
n:								
itarian Church		54	04.57		05	19.92	do	Do.
n works, chimney		52	54.11		05	38.55	do	Do.
aph		50	59.36		06	50.33	do	Do.
		46	31.46		06	43.07	do	Do.
er		52	22.47		05	16.73	do	Do.
ation:								
th base		50	13.04		21	28.68	do	Do.
rth base		54	25.94		21	20.68	do	Do.
r		54	23.22		02	57.83	do	Do.
urn		53	25.41		01	56.49	do	Do.
tower		59	46.52		19	21.66	do	Do.
works		54	11.20		03	50.62	do	Do.
moe		53	08.94		02	30.19	do	Do.
		54	40.30		05	11.67	do	Do.
ns		52	43.06		05	52.70	do	Do.
ore		52	12.51		05	31.91	do	Do.
		45	03.10		08	27.35	do	Do.
		54	19.08		02	44.92	do	Do.

RHODE ISLAND.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Achilles	41	19	15.35	71	48	47.54	C. & G. S	Rept. '85.
Ajax		20	35.86		41	17.40	do	Do.
Aldrich		50	23.92		40	11.00	do	Bull. 122.
Anderson, barn cupola		33	41.31		17	23.46	do	Rept. '85.
Anthony		38	46.35		13	18.64	do	Do.
Mill		41	47.30		32	47.82	do	Bull. 122.
Apponaug, spire		41	55.84		27	30.08	do	Rept. '85.
Arnold		45	14.48		23	41.75	do	Do.
Austin		24	25.28		28	44.90	do	Do.
Babcock		42	44.36		18	24.80	do	Do.
Balch, house, north chimney		29	00.51		16	20.91	do	Do.
Barber Height		31	44.87		25	28.10	do	Do.
Barker		38	23.01		12	06.65	do	Do.
Barn cupola		32	08.72		22	36.98	do	Do.
Barn, white cupola		42	22.66		16	55.43	do	Do.
Barn, west gable		28	35.10		23	28.36	do	Do.
Batty		32	13.24		22	36.23	do	Do.
Farm		45	34.90		24	35.80	do	Do.
Beaconpole		59	42.47		27	01.26	do	Do.
Beaconpole (Borden)		00	03.26		26	43.16	do	Do.
Beavertail, light-house		26	56.86		23	59.42	do	Do.
Do		26	57.89		23	59.57	do	Do.
Bentley		21	51.91		45	33.28	do	Do.
Big Hill		23	26.36		46	08.49	do	Do.
Block Island		10	32.08		35	30.64	do	Do.
Derrick		09	10.01		33	08.80	do	Do.
North light-house (1874)		13	39.66		34	34.74	do	Do.
North light-house (1838)		13	29.15		34	33.05	do	Do.
Southeast light-house (1875)		09	10.12		33	08.39	do	Do.
Border Hill, topographical pole		23	26.74		38	29.70	do	Do.
Boston Neck		28	19.08		26	05.43	do	Do.
Bristol:								
Court-house		40	12.66		16	25.67	do	Do.
Methodist church		40	15.39		16	31.88	do	Do.
Broad Hill		24	39.95		33	42.82	do	Do.
Brown (E.), house chimney		19	54.22		45	25.62	do	Do.
Brown (E.), house cupola		45	04.44		23	24.20	do	Do.
Browning, house chimney		32	00.82		25	49.54	do	Do.
Browning (W.T.), house, center chimney.		23	12.44		34	36.28	do	Do.
Bullock Neck (Borden)		44	42.27		21	35.11	do	Do.
Bullock Neck		44	42.90		21	27.69	do	Do.
Bullock Neck, 2		44	43.00		21	35.16	do	Do.
Bunker Hill		23	10.16		39	16.35	do	Do.
Bushy Hill		12	43.99		33	40.56	do	Do.
Buttonwood House, cupola		41	19.12		25	58.28	do	Do.
Butts		36	55.84		15	06.56	do	Do.
Butts, 2		36	55.74		15	07.48	do	Do.
Calf Pasture Point		37	40.62		24	18.99	do	Do.
Castle Hill		27	53.02		21	28.80	do	Do.
Castle Island Beacon (1843)		39	13.97		17	12.20	do	Do.
Champlin		29	16.00		46	47.77	do	Do.
Do		29	16.04		46	47.91	G. S	Bull. 122.
Church Point		30	00.12		12	23.96	C. & G. S	Rept. '85.
Church Point, 2		30	09.92		12	21.01	do	Do.
Coal Mines, middle chimney		37	09.94		16	26.83	do	Do.
College Hill		50	18.85		24	00.63	do	Do.
Commons		21	15.21		43	54.70	do	Do.
Conanicut, north		34	24.86		22	19.87	do	Do.
Conimicut		43	01.67		21	29.44	do	Do.
Cormorant Hill		23	37.22		49	03.45	do	Do.
Cornell		37	18.96		09	16.52	do	Do.
Cranberry Hill		20	53.23		47	22.77	do	Do.
Cranberry Hill, 2		20	53.40		47	22.80	do	Do.
Davis (O.), house, east gable chimney		20	56.91		44	09.26	do	Do.
Dawley		32	12.06		39	02.68	do	Bull. 122.
Diamond Hill, tree		25	46.62		46	28.73	do	Rept. '85.
Dumplin		28	45.68		22	07.86	do	Do.
Dumplin, 2		28	45.69		22	07.86	do	Do.
Dunn House, white chimney		21	06.38		46	07.44	do	Do.
Dutch Island:								
Flagstaff (1868)		30	19.30		24	04.75	do	Do.
Light-house (1868)		29	48.28		24	17.18	do	Do.
Dyer Island		34	57.25		17	55.49	do	Do.
East Rock		27	04.65		11	38.34	do	Do.
Fairground, tower		31	16.61		16	27.84	do	Do.
Fishhouse, chimney		34	41.97		26	51.84	do	Do.
Fogland Point House		33	42.90		13	11.65	do	Do.
Fort Adams:								
Flagstaff (1869)		28	45.88		20	20.25	do	Do.
Flagstaff (1843)		28	47.51		20	14.24	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Fort Hill	41	20	01.27	71	49	15.13	C. & G. S	Rept. '85.
Fort Independence		47	34.44		23	33.38	do	Do.
Fort Independence, 2		47	34.41		23	33.49	do	Do.
Four Corners, belfry		34	31.52		11	22.41	do	Do.
Fox Island		33	16.24		25	04.48	do	Do.
House chimney		33	15.00		25	06.59	do	Do.
Fox Point, rolling-mill chimney		48	59.70		23	55.82	do	Do.
Franklin		35	41.35		33	56.30	do	Bull. 122.
Gibbs		29	36.69		16	29.18	do	Rept. '85.
Gibbs, 2		29	39.54		16	28.38	do	Do.
Goat Island, light-house (1843)		29	36.09		19	39.10	do	Do.
Gould Island		32	04.30		20	42.02	do	Do.
Barn cupola		32	02.03		20	41.06	do	Do.
Governors Island		21	19.42		39	12.29	do	Do.
Green, barn cupola		33	42.34		26	31.25	do	Do.
Green Hill		22	24.70		35	51.59	do	Do.
Green Point		41	03.60		24	43.18	do	Do.
Griswold, barn, south cupola		32	58.69		14	20.83	do	Do.
Halfway Rock		33	49.82		19	58.34	do	Do.
Hall		43	12.06		17	05.59	do	Do.
Hall (Ben), house, west chimney		35	08.27		16	41.43	do	Do.
Hamilton Mills, cupola		32	57.49		26	17.05	do	Do.
Harris, barn, east cupola		22	19.74		40	22.64	do	Do.
Hazard (A. P.)		28	23.25		19	17.59	do	Do.
House, center chimney		24	34.68		33	04.20	do	Do.
Castle		24	55.10		27	28.37	do	Do.
Hector		19	31.66		47	20.57	do	Do.
High Hill		32	51.03		12	59.46	do	Do.
High Rocks		37	47.56		26	08.78	do	Do.
Hiscox		21	29.18		42	14.56	do	Do.
Hog Island		38	40.38		16	50.58	do	Do.
Hog Island, 2		38	40.48		16	50.79	do	Do.
Hog Island, 3		38	40.48		16	50.82	do	Do.
Hope Island		36	10.30		21	59.62	do	Do.
Barn		36	09.97		22	00.42	do	Do.
Howland, barn cupola		32	04.17		11	46.08	do	Do.
Hull		32	14.56		22	36.23	do	Do.
James		32	41.81		39	52.97	do	Do.
Joshua Champlin		22	16.39		39	55.33	do	Do.
Kenyon		23	25.33		37	01.43	do	Do.
Kenyon (H. G.), house, center chimney.		22	56.41		37	06.67	do	Do.
Kettle Point		47	46.34		22	41.04	do	Do.
Kingston, church spire		28	48.90		31	33.54	do	Do.
Kinnicut		47	47.84		21	57.48	do	Do.
Knapp Point, house chimney		18	22.53		53	07.63	do	Do.
Lawton, house, flagstaff		37	33.40		12	48.97	do	Do.
Liberty Pole		21	41.54		37	21.90	do	Do.
Little Compton		31	12.38		11	00.71	do	Do.
Little Compton, 2 (1870)		31	12.44		11	01.69	do	Do.
Church spire		30	33.63		10	18.35	do	Do.
McSparrow		29	46.95		27	24.74	do	Do.
McSparrow, 2		29	47.79		27	24.35	do	Do.
Meetinghouse Hill		26	45.32		28	33.93	do	Do.
Meetinghouse Hill, 2		26	43.17		28	33.55	do	Do.
Miantonomy		30	37.05		18	37.43	do	Do.
Mound		38	14.04		13	11.91	do	Do.
Mount Hope (Borden)		40	27.55		14	26.15	do	Do.
Mount Hope		40	26.13		14	26.21	do	Do.
Mount Hope, 2		40	26.52		14	26.09	do	Do.
Mumford, Cranston		46	13.10		33	15.83	do	Bull. 122.
Munroe (Borden)		46	34.35		19	05.61	do	Rept. '85.
Narragansett, church		29	33.60		25	33.46	do	Do.
Narragansett Bay, yellow barn cupola		41	01.77		27	13.58	do	Do.
Nayatt light-house (1863)		43	30.64		20	21.88	do	Do.
Nayatt light-house (1843)		43	30.09		20	22.31	do	Do.
Neutaconkanut		48	41.08		28	03.06	do	Do.
Newport:								
Bronson's house flagstaff		27	51.76		21	28.23	do	Do.
Church		29	14.46		18	49.71	do	Do.
Belmont's house cupola		27	52.17		18	22.46	do	Do.
Catholic church spire		28	49.06		18	49.38	do	Do.
Ocean House		28	53.24		18	30.59	do	Do.
New Weeden		22	54.29		33	16.31	do	Do.
North Popasquash		40	54.61		18	12.28	do	Do.
North Windmill		35	16.01		15	16.18	do	Do.
Northeast corner of Connecticut		01	24.82		48	04.20	do	Do.
Northwest corner of Rhode Island		00	29.15		47	58.92	do	Do.
Noyes Neck		19	46.49		45	19.84	do	Do.
Noyes Point		19	46.31		45	19.44	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Nye's (R.) house, white chimney	41	21	54.53	71	46	28.12	C. & G. S	Rept. '85.
Paine		09	18.85		33	44.99	do	Do.
Pappoose Squaw		39	15.20		18	02.52	do	Do.
Pappoose Squaw, 2		39	15.20		18	02.45	do	Do.
Paradise Rock		30	05.51		15	45.50	do	Do.
Patience		39	33.47		21	24.58	do	Do.
Pawhungernock, church		30	20.06		50	25.46	do	Do.
Pawtucket:								
Spire		52	36.04		22	53.84	do	Do.
Dark spire		52	53.95		23	05.06	do	Do.
Pawtuxet		45	56.80		23	13.95	do	Do.
Borden		45	14.19		23	41.72	do	Do.
Beacon (1843)		45	35.56		22	50.95	do	Do.
Church spire		45	59.12		23	30.53	do	Do.
Peleg Tiff		23	18.75		48	40.42	do	Do.
Peirce:								
Barn		48	22.47		22	59.79	do	Do.
Barn cupola		25	34.08		28	50.74	do	Do.
Pine Hill		38	00.47		20	35.81	do	Do.
Pocasset		39	09.42		11	32.36	do	Do.
Point Judith		21	54.84		29	17.94	do	Do.
Light-house (1838)		21	39.88		28	54.73	do	Do.
Pojack		39	04.92		24	27.97	do	Do.
Pomham		46	42.15		21	28.04	do	Do.
Beacon (1843)		46	35.13		22	27.08	do	Do.
Poorhouse:								
Belfry		30	26.86		19	43.31	do	Do.
Northeast gable		35	21.98		24	50.76	do	Do.
Portsmouth, belfry		36	13.34		14	53.67	do	Do.
Portsmouth Grove, flagstaff		35	13.03		17	13.73	do	Do.
Potter's windmill shaft		30	56.30		22	28.66	do	Do.
Potter's (widow) barn		33	18.00		12	17.07	do	Do.
Potter's (A.) house chimney		30	29.90		21	38.60	do	Do.
Potter's (Dr.) house chimney		27	00.95		26	30.46	do	Do.
Prince		44	34.61		18	56.32	do	Do.
Prospect Hill		49	44.64		24	20.85	do	Do.
Providence:								
Baptist church		49	38.92		24	32.12	do	Do.
Congregational church		49	12.90		24	50.78	do	Do.
High Street church		49	05.73		25	16.25	do	Do.
Unitarian church		49	27.89		24	19.99	do	Do.
Quaker College		50	00.56		23	56.34	do	Do.
Vitriol works chimney		49	49.56		25	21.92	do	Do.
Prudence		36	24.42		18	42.59	do	Do.
2 (1869)		36	22.23		18	41.81	do	Do.
Island, light-house (1861)		36	21.34		18	14.46	do	Do.
Island, light-house (1869)		36	28.93		18	30.35	do	Do.
South		34	44.45		19	32.96	do	Do.
Quaker		34	57.38		15	18.34	do	Do.
Quonochontaug		19	59.99		42	37.33	do	Do.
Quonsett		35	26.58		24	33.70	do	Do.
Quonsett, 2		35	16.90		24	23.02	do	Do.
Quonsett, 3 (1868)		35	17.03		24	23.20	do	Bull. 122.
Reynolds		33	45.55		26	52.10	do	Rept. '85.
Rocky Point		41	29.72		21	50.06	do	Do.
Hotel chimney		41	21.91		21	56.52	do	Do.
Rose Island		29	48.20		20	34.44	do	Do.
Flagstaff		29	47.52		20	34.30	do	Do.
Rumstick		42	24.05		18	07.76	do	Do.
Sable Point		46	02.38		22	06.14	do	Do.
Sakonnet Point		27	16.36		11	46.09	do	Do.
Sanders's (E.) house chimney		20	26.32		44	46.60	do	Do.
Sandford, mill cupola		33	05.93		26	53.50	do	Do.
Sandhill		21	40.62		42	17.39	do	Do.
Sandy Point		39	43.29		24	37.14	do	Do.
Schoolhouse chimney		32	18.25		22	33.32	do	Do.
Seventh-Day meetinghouse, north chimney.		23	36.04		36	30.00	do	Do.
Shannock		28	05.19		38	21.49	do	Do.
Shaw's (Peter) barn cupola		29	14.50		08	45.72	do	Do.
Sherman		30	16.94		30	56.19	G. S	Bull. 122.
Sherman		30	16.94		30	56.02	C. & G. S	Rept. '85.
Sherman's (J. P.) house center chimney.		23	25.18		31	45.62	do	Do.
Sherman, house chimney		33	47.42		22	24.25	do	Do.
Signal flag		35	32.16		25	42.20	do	Do.
Simmons		29	32.29		09	34.21	do	Do.
Simmons, 2		29	32.08		09	34.66	do	Do.
Slate		32	21.01		15	59.64	do	Do.
Slate Hill, flagstaff (1869)		32	22.15		15	56.41	do	Do.
Smith, barn cupola		36	00.02		25	23.04	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	71°-72°		
South Portsmouth:	° ′ ″	° ′ ″		
Episcopal church tower	41 32 50.30	71 15 42.34	C. & G. S	Rept. '85.
Union church tower	33 30.18	15 21.90	do	Do.
South Rock	34 26.66	25 03.67	do	Do.
Spar Island	41 17.40	13 14.68	do	Do.
Spencer	40 43.26	29 40.68	do	Do.
Spencer (2), Warwick	40 38.87	29 49.30	do	Bull. 122.
Stargut Island, house, north gable	47 10.00	22 55.92	do	Rept. '85.
Stevens	44 44.13	22 56.05	do	Do.
Sugarloaf Hill	26 04.96	30 40.02	do	Do.
Tefft:				
Barn cupola	31 32.92	25 34.92	do	Do.
House chimney	28 01.34	27 37.94	do	Do.
Telegraph	27 47.83	20 11.63	do	Do.
Telegraph, 2	27 47.28	20 11.61	do	Do.
Tiff	27 48.56	32 15.70	do	Bull, 122.
Tiverton, cupola	37 30.25	12 50.91	do	Rept. '85.
Topographical pole, near post road	23 41.82	35 54.60	do	Do.
Topographical pole, 3	23 17.94	35 17.72	do	Do.
Topographical pole, 4	23 59.28	32 40.78	do	Do.
Topographical pole, 6	24 00.68	33 31.32	do	Do.
Tourtellot, Gloucester	53 40.34	39 16.48	do	Bull. 122.
Tower Hill, church	28 02.85	27 35.23	do	Rept. '85.
Toweset	41 59.23	14 33.74	do	Do,
Toweset Neck (Borden)	42 45.02	13 36.28	do	Do.
Vaughn, house cupola	34 25.62	27 45.68	do	Do.
Village Hill	20 54.17	44 59.29	do	Do.
Vue de l'Eau Hotel	47 15.82	22 05.09	do	Do.
Wakefield:				
Flagstaff	26 05.03	30 40.05	do	Do.
Church, gray spire	26 25.58	29 50.95	do	Do.
Church, white spire	26 24.25	30 11.06	do	Do.
Warren:				
Spire	43 48.47	17 04.14	do	Do.
Methodist spire	43 48.78	17 02.72	do	Do.
Beacon (1863)	42 48.74	17 37.24	do	Do.
Warwick beacon (1843)	39 25.02	23 36.17	do	Do.
Warwick light-house (1863)	40 01.43	22 43.28	do	Do.
Warwick Neck	41 21.10	22 49.72	do	Do.
Watch Hill	18 49.93	51 17.20	do	Do.
Light-house	18 14.19	51 32.43	do	Do.
Watson, house chimney	28 22.37	26 05.70	do	Do.
Weaver, Coventry	39 37.21	39 49.84	do	Bull. 122.
Weeden	22 50.89	33 15.24	do	Rept. '85.
Well Hill	25 56.65	45 15.92	do	Do.
West	38 44.42	15 42.00	do	Do.
West Island, New York Club flagstaff (1869).	27 00.81	11 59.03	do	Do.
Westerly	21 59.88	40 52.84	do	Do.
Wharton's (D.) house, east chimney	24 56.65	27 16.49	do	Do.
White House:				
West chimney	23 20.46	29 18.66	do	Do.
North chimney	40 46.09	27 04.36	do	Do.
Whitman	40 33.89	27 19.36	do	Do.
Wickford	34 30.54	28 02.69	do	Do.
Academy	34 06.68	27 21.19	do	Do.
Baptist church	34 19.58	27 05.35	do	Do.
Light-house (1868)	34 15.92	26 22.59	do	Do.
Spire	34 23.40	27 00.02	do	Do.
Wilbur	29 29.63	38 32.54	do	Do.
Windmill	29 24.36	11 02.56	do	Do.
Wilcox	21 23.20	43 59.86	do	Do.
Windmill	32 33.62	11 50.48	do	Do.
Windmill, 2 (1869)	32 33.56	11 50.51	do	Do.
Wing	35 23.22	11 10.35	do	Do.
Woonsocket	58 40.81	33 15.16	do	Bull. 122.
Yellow barn, cupola	22 31.40	37 26.60	do	Rept. '85.
Yellow house, chimney	43 41.87	19 23.20	do	Do.

CONNECTICUT.

	42°-43°	73°-74°		
	° ′ ″	° ′ ″		
Ball Peak, Mount Riga	42 00 43.33	73 27 57.84	C. & G. S	Rept. '88.
Connecticut line (Borden)	02 58.78	29 42.92	do	Do.
	41°-42°	71°-72°		
Atwoods, machine works cupola	41 19 49.32	71 54 26.23	do	Do.
Box Hill	47 59.79	27 21.40	do	Bull. 122,

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Chapman Hill	41	29	32.28	71	51	40.57	C. & G. S	Bull. 122.
Eels Hill, 2		22	49.87		51	04.85	do	Rept. '85.
Frost		20	57.57		51	03.25	do	Rept. '88.
Grant Hill		25	25.17		54	06.05	do	Do.
Jesse Main		26	31.63		49	15.00	do	Do.
Lantern Hill		27	37.93		56	40.83	do	Do.
Morgan Point, light-house (1874–1886)		18	59.43		59	23.67	do	Do.
Mount Riga (on Ball Peak)		00	43.33		27	57.84	do	Rept. '85.
Noank, spire (1882)		19	33.76		59	13.14	do	Do.
North Stonington		25	59.53		51	20.72	do	Do.
Northeast corner of Connecticut (Borden).		01	24.82		48	04.20	do	Do.
Palmer		21	37.29		55	41.92	do	Rept. '88.
Portersville, spire (1835)		21	14.80		58	24.87	do	Do.
Powkhungemock church (1838)		30	20.06		50	25.46	do	Do.
Quacatog		23	15.29		56	58.57	do	Do.
Ram Island:								
Hotel flagstaff		18	40.34		58	46.45	do	Do.
Reef Spindle (1835)		18	23.16		58	29.42	do	Do.
Road Meetinghouse (1838)		22	23.44		54	51.18	do	Do.
Sandford		27	42.80		56	59.30	do	Rept. '85.
Stonington:								
Meetinghouse (1835)		20	12.24		54	21.08	do	Rept. '88.
Harbor, light-house (1873–1886)		19	42.72		54	21.59	do	Do.
Walnut Hill		25	14.80		54	35.66	do	Do.
Wamposset		19	44.65		55	16.93	do	Do.
Wilcox, fish works, brick chimney		19	59.45		57	13.04	do	Do.
	41°-42°			72°-73°				
Allen	41	17	40.30	72	58	23.88	do	Do.
Arnold Quarry		28	26.06		30	28.54	do	Do.
Avery Hill		28	02.99		02	58.71	do	Do.
Avery Hill, 2		20	21.52		04	05.25	do	Do.
Avery Point		18	57.59		03	52.58	do	Do.
Avery Point, 2 (1882)		18	57.02		03	52.68	do	Do.
Ayer		19	55.92		21	38.38	do	Do.
Bailey		22	51.64		04	56.93	do	Do.
Bald Hill		58	25.89		11	55.03	do	Bull. 122.
Do		27	43.10		25	06.86	do	Rept. '88.
Baldwin		24	06.00		04	40.25	do	Do.
Barker		15	15.84		48	34.22	do	Do.
Bartlett		14	54.10		42	44.85	do	Do.
Beacon		18	48.03		03	58.98	do	Do.
Hill		17	34.65		24	08.85	do	Do.
Hill, 3 (1882)		17	34.38		24	09.32	do	Do.
Beckwith		21	12.50		21	23.04	do	Do.
Bethany:								
Church spire		25	30.92		59	47.33	do	Do.
South		23	34.15		58	03.90	do	Do.
Bigelow's house, chimney		18	09.63		54	04.21	do	Do.
Bill Hill		20	11.29		59	08.35	do	Do.
Block Point		17	09.68		12	19.75	do	Do.
Block Point, 2 (1882)		17	11.78		12	17.37	do	Do.
Bluff Point		18	53.97		02	04.97	do	Do.
Bog Hole Hill		18	49.74		18	56.90	do	Do.
Bog Hole Hill, 2 (1861)		18	49.74		18	56.95	do	Do.
Bolles Hill		27	49.24		04	43.04	do	Do.
Book Hill		22	06.53		24	47.38	do	Do.
Boulder		14	34.79		42	21.46	do	Do.
Bradley		17	14.20		49	28.04	do	Do.
Brainerd		29	18.49		31	35.95	do	Do.
Branford, Congregational church spire (1876).		16	52.22		48	40.61	do	Do.
Branford Reef, beacon (1881–1882)		13	16.78		48	20.68	do	Do.
Brethren		24	53.18		55	48.69	do	Do.
Brewster's Factory cupola		18	09.46		54	38.72	do	Do.
Bridge		17	33.28		55	59.19	do	Do.
Broadway church		31	34.05		04	33.65	do	Do.
Brockway		23	23.64		23	18.73	do	Do.
Brooks		25	24.26		25	42.99	do	Do.
Browning		25	05.54		06	23.63	do	Do.
Buckingham		22	56.35		23	47.90	do	Do.
C		16	14.33		54	21.20	do	Do.
Camp Hill		16	30.41		34	13.41	do	Do.
Canal Dock		17	38.30		54	52.73	do	Do.
Case		22	31.63		53	32.34	do	Do.
Cedar		31	08.33		05	25.87	do	Do.
Do		22	41.98		23	40.05	do	Do.
Do		17	43.14		57	44.57	do	Do.
Centerville, church		23	01.59		54	11.50	do	Do.
Champion House flagstaff		27	42.76		27	53.32	do	Do.
Chapin		18	01.01		06	45.28	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Charleston, cupola	41	31	41.22	72	04	50.63	C. & G. S	Rept. '88.
Chemical works ventilator		16	07.90		54	07.34	do	Do.
Cheshire, church spire		29	52.78		54	12.18	do	Do.
Chester:								
Landing		24	50.52		25	45.96	do	Do.
Spire		24	04.64		27	15.16	do	Do.
Chestnut, 1 (1875)		21	56.86		57	05.62	do	Do.
Chestnut, 2 (1875)		23	12.86		55	28.34	do	Do.
Chestnut Hill		31	27.38		25	53.56	do	Do.
Clark Point		14	00.32		58	43.15	do	Do.
Clinton, church spire (1882)		16	39.89		31	38.74	do	Do.
Cornfield Point		15	42.21		23	14.28	do	Do.
Cornfield Point, 2 (1882)		15	42.48		23	14.73	do	Do.
Cone		24	38.76		26	52.80	do	Do.
Do		17	55.09		50	58.03	do	Do.
Corner stone		24	03.62		05	27.44	do	Do.
Cow Hill		17	44.40		32	29.65	do	Do.
Cow Point		24	32.33		05	33.94	do	Do.
Crane Bar		17	06.14		54	13.95	do	Do.
Cromwell, Congregational church		35	48.75		38	46.76	do	Do.
Deep River spire		23	12.14		26	04.78	do	Do.
Dickerman		25	06.94		55	42.34	do	Do.
Dike		17	01.99		56	16.54	do	Do.
Doane		22	27.19		24	47.58	do	Do.
Doolittle		22	25.18		58	48.29	do	Do.
Dragon, brick church, spire		18	35.18		53	26.31	do	Do.
Duck Island		15	23.67		28	33.14	do	Do.
Duck Island, 2 (1882)		15	23.91		28	33.26	do	Do.
Fair Haven:								
Spire		18	35.20		53	26.33	do	Do.
Second Congregational church		18	27.90		53	08.81	do	Do.
Falkner Island, light-house (1833–1882)		12	43.18		39	14.45	do	Do.
Falls liberty pole		32	08.89		05	28.42	do	Do.
Fellows		31	06.86		04	09.50	do	Do.
Fenwick Hall, flagstaff		16	20.43		21	15.03	do	Do.
Ferry		18	57.92		21	56.98	do	Do.
Ferry, 2 (1861)		18	57.91		21	57.00	do	Do.
Fish house		15	49.62		27	53.71	do	Do.
Flagstaff		31	01.07		04	53.78	do	Do.
East		16	58.77		53	58.50	do	Do.
East Haddam:								
Congregational church		28	49.29		26	48.97	do	Do.
Episcopal church		27	37.70		27	33.73	do	Do.
East Hartford, square steeple, green blinds.		46	08.56		38	41.38	do	Do.
East Haven:								
Flagstaff (1875)		16	32.08		52	04.15	do	Do.
Spire		16	41.82		52	19.72	do	Do.
East Rock		19	37.42		54	17.44	do	Do.
East Rock, 2 (1871)		19	42.43		54	26.32	do	Do.
Edgecombe House, flagstaff		19	31.46		04	31.67	do	Do.
Ely		21	51.48		22	27.20	do	Do.
Ely, 2 (1861)		21	51.48		22	27.19	do	Do.
Ely, 3 (1861)		21	52.97		22	24.74	do	Do.
Emmons		32	06.35		32	07.63	do	Do.
Essex		20	33.36		23	49.09	do	Do.
Baptist church		21	18.26		23	33.57	do	Do.
Congregational church		21	09.96		23	34.24	do	Do.
Episcopal church (1861)		21	11.08		23	32.43	do	Do.
Essex, 2 (1861)		20	33.33		23	49.09	do	Do.
Forbes		17	47.40		54	07.40	do	Do.
Fort Hale, 2 (1874)		16	14.79		54	18.57	do	Do.
Fort Hill, 2 (1882)		20	47.82		00	40.65	do	Do.
Fort Trumbull, flagstaff (1882)		20	38.28		05	39.16	do	Do.
Fort Wooster, 3 (1882)		16	55.92		53	35.12	do	Do.
Four Mile River, 2 (1882)		18	12.40		16	13.48	do	Do.
Fresenius Brewery cupola		17	56.34		56	36.16	do	Do.
Gelston		26	57.58		26	31.49	do	Do.
Giant Head		25	35.82		53	59.06	do	Do.
Goshen		17	57.65		06	47.94	do	Do.
Granby		55	57.08		53	18.88	G. S	Bull. 122.
Grassy Hill, church		23	45.56		17	16.50	C. & G. S	Rept. '88.
Gravel Bluff		19	20.44		21	05.84	do	Do.
Graves		17	52.84		36	51.65	do	Do.
Great Hummock		15	35.22		30	43.34	do	Do.
Great Rock		20	31.54		51	11.30	do	Do.
Green Hill		49	00.26		23	14.32	G. S	Bull. 122.
Griswold		17	30.24		39	36.26	C. & G. S	Rept. '88.
Groton Hill		22	38.27		04	54.20	do	Do.
Groton Long Point		18	26.80		00	21.29	do	Do.
Groton Long Point, 2 (1882)		18	25.09		00	19.93	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Groton Monument	41	21	18.02	72	04	47.45	C. & G. S	Rept. '88.
Grove		19	02.97		52	57.23	do	Do.
Guard House Point, chimney		15	51.14		22	04.12	do	Do.
Haddam:								
Academy		28	44.81		30	59.76	do	Do.
Congregational church		28	45.82		30	56.05	do	Do.
Court-house		28	50.68		31	00.62	do	Do.
Haddam Neck		28	55.33		29	28.36	do	Do.
Congregational church		31	47.50		32	13.46	do	Do.
Methodist church		30	54.47		30	53.26	do	Do.
Flag		29	37.60		30	30.18	do	Do.
Hadlyme, church cupola		25	53.58		24	21.36	do	Do.
Hamburg Cove		22	36.66		22	21.00	do	Do.
Hamden Methodist church		21	11.38		55	53.14	do	Do.
Hammonasset, hotel chimney		16	17.35		35	10.39	do	Do.
Hammonasset, 2 (1882)		14	55.84		32	40.59	do	Do.
Harrison		18	00.48		49	45.16	do	Do.
Hartford:								
South Congregational church		45	34.82		40	33.35	do	Do.
Arsenal flagstaff		46	51.85		40	34.00	do	Do.
Colt's factory		45	24.28		39	48.90	do	Do.
Old State House cupola		45	58.03		40	23.38	do	Do.
Windsor avenue church		46	56.74		40	33.74	do	Do.
Hatchett Point		16	58.81		15	43.53	do	Do.
Hatchett Point, 2 (1882)		17	03.53		15	45.75	do	Do.
Hayden Point		20	37.22		22	38.52	do	Do.
Hemlock		22	27.28		59	03.64	do	Do.
Hemmingway		18	58.19		52	12.37	do	Do.
Hen and Chickens beacon (1882)		15	12.16		24	18.33	do	Do.
Higganum:								
Congregational church		29	51.13		33	20.29	do	Do.
Methodist church		29	54.66		33	49.49	do	Do.
High Hill		20	37.57		37	41.95	do	Do.
Highlands		15	56.18		38	57.53	do	Do.
High Rock		24	18.25		56	07.91	do	Do.
Hillhouse		19	40.61		59	48.57	do	Do.
Hillside		22	52.58		57	57.35	do	Do.
Hoadley Neck		15	27.53		44	10.04	do	Do.
Hogshead Point		16	10.60		38	15.26	do	Do.
Holt		25	41.32		27	29.89	do	Do.
Honey Hill		23	49.83		21	34.38	do	Do.
Horse Pond		17	36.20		35	20.92	do	Do.
Horse, cupola of house		14	39.86		45	31.03	do	Do.
Hotchkiss		23	43.87		58	53.50	do	Do.
Howard, 1 (1876)		24	31.72		52	18.81	do	Do.
Howard, 2 (1877)		24	51.14		52	33.05	do	Do.
Huddenston		26	57.06		58	24.78	do	Do.
Hungry Hill		18	49.90		41	33.02	do	Do.
Ives cupola		18	31.69		52	52.00	do	Do.
Indian Neck		15	23.82		49	19.76	do	Do.
Insane asylum, northwest chimney		33	08.02		37	50.08	do	Do.
Jail Hill		31	41.16		04	49.15	do	Do.
Jeremy:								
North		16	13.51		56	03.18	do	Do.
South		15	39.47		56	02.96	do	Do.
Jewett		18	46.91		58	22.14	do	Do.
Joe Post light (1861)		23	20.35		25	05.28	do	Do.
Johnny Cake		45	12.79		59	41.01	G. S	Bull. 122.
Jones		27	59.34		27	32.46	C. & G. S	Rept. '88.
Do		15	37.80		58	25.79	do	Do.
Jordan, church tower		18	31.00		07	42.35	do	Do.
Joshua Rock		22	51.84		22	37.80	do	Do.
Kelsey Clinton		15	24.44		30	27.65	do	Do.
Kelsey Westbrook		16	27.00		25	28.46	do	Do.
Kongscut		41	44.35		30	10.15	do	Do.
Lancrofts, cupola		18	05.15		53	17.68	do	Do.
Lay Hill		16	58.26		18	02.04	do	Do.
Lay Hill, 2 (1861)		16	58.20		18	02.06	do	Do.
Lay Hill, 3 (1882)		16	57.93		18	01.84	do	Do.
Lebanon		26	26.56		59	38.96	do	Do.
Ledge		25	07.39		05	17.74	do	Do.
Lewis		19	14.73		12	03.15	do	Do.
Lewis Grove		16	16.03		29	08.62	do	Do.
Locust		25	02.22		27	17.72	do	Do.
Long Hill		26	45.49		30	24.97	do	Do.
Do		17	26.35		30	47.08	do	Do.
Do		24	08.31		53	09.57	do	Do.
Lord		21	30.88		20	47.42	do	Do.
Lower Pole Hill		27	11.69		07	31.19	do	Do.
Lyme, white Congregational church (1835-1883).		18	46.45		19	56.04	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Madison:								
Church spire (1838)	41	16	44.80	72	36	08.35	C. & G. S	Rept. '88.
Congregational church spire (1882)		16	47.90		36	12.79	do	Do.
Malicah		20	35.17		20	09.23	do	Do.
Manetuck		21	15.56		09	03.16	do	Do.
Manetuck, 2 (1882)		21	15.26		09	03.53	do	Do.
Mansfield		21	52.39		50	20.97	do	Do.
Mason		30	30.13		04	41.83	do	Do.
Maynard		26	10.51		04	14.49	do	Do.
Meeting House Hill		36	08.68		08	38.97	G. S	Bull. 122.
Menunketesuck		15	42.73		27	48.99	C. & G. S	Rept. '88
Merritt		24	23.65		56	30.69	do	Do.
Middletown:								
Catholic church		33	59.08		39	11.92	do	Do.
Indian Hill Cemetery, summer-house.		33	17.08		39	48.19	do	Do.
North Congregational church		33	36.59		39	05.42	do	Do.
South Congregational church		33	23.25		38	51.74	do	Do.
Wesleyan College chapel		33	20.72		39	23.04	do	Do.
Mill Rock		16	48.22		51	47.65	do	Do.
Millstone Point		18	18.92		09	54.44	do	Do.
House, west chimney		18	30.40		10	08.21	do	Do.
Mohican:								
Church spire (1838)		28	23.88		05	55.31	do	Do.
Church spire (1874)		28	23.90		05	55.40	do	Do.
Montowese church		20	55.49		51	45.80	do	Do.
Morgan Point		14	32.70		53	39.53	do	Do.
Moose Hill, New Haven		18	22.56		44	34.18	do	Do.
Moodus		31	13.47		27	32.64	do	Do.
Mound		30	32.65		05	13.43	do	Do.
Mount Carmel		25	51.80		53	25.64	do	Do.
Mount Ephraim		27	47.45		54	56.64	do	Do.
Mount Parnassus		28	03.61		24	40.54	do	Do.
Mount Prospect		28	22.70		58	16.34	do	Do.
Mulberry Point		15	37.52		40	55.47	do	Do.
Murdock		17	10.50		28	20.94	do	Do.
Murdock, 2 (1882)		17	06.83		28	21.73	do	Do.
New England Cement Works, smoke-stack.		22	36.18		58	39.97	do	Do.
New Haven:								
First Congregational church		18	34.78		53	38.15	do	Do.
Baptist church		18	33.50		53	23.82	do	Do.
Light-house (1833–1882)		14	56.40		54	15.13	do	Do.
City Hall		18	26.57		55	29.87	do	Do.
Almshouse cupola		18	55.57		57	08.48	do	Do.
Scientific School, observatory tower.		18	42.77		55	32.63	do	Do.
St. Paul's Episcopal church, southwest spire.		18	13.74		55	13.86	do	Do.
St. Patrick's church		18	30.72		54	42.41	do	Do.
Grace church		18	25.50		53	57.08	do	Do.
South church		17	53.48		55	52.88	do	Do.
Custom-House Square, flagstaff		18	02.82		55	26.63	do	Do.
Schoolhouse cupola		18	35.19		53	26.32	do	Do.
Long Wharf light-house (1873)		17	33.82		54	56.49	do	Do.
New London:								
First Congregational church (1882).		21.	18.23		05	50.38	do	Do.
Second Congregational church (1882).		21	26.34		06	06.30	do	Do.
Light-house (1835–1886)		18	59.99		05	24.68	do	Do.
Niantic, spire		19	39.00		11	35.04	do	Do.
Nickerson		23	53.85		19	39.56	do	Do.
No Name		26	41.35		57	30.62	do	Do.
North		17	35.88		54	15.85	do	Do.
North Glastonbury, Congregational church.		42	31.86		36	31.92	do	Do.
North Guilford church spire		22	05.84		43	39.44	do	Do.
North Haven church spire		23	12.97		51	42.66	do	Do.
North Hill		22	36.82		49	18.43	do	Do.
North Killingworth, Congregational church (1836–1882).		21	47.07		33	58.07	do	Do.
North Pond Rock		19	00.52		50	17.48	do	Do.
North Quinnipiac		19	28.71		53	20.77	do	Do.
North Sheffield College:								
Larger observatory in college grounds.		18	47.00		55	30.89	do	Do.
South chimney lightning rod		18	45.96		55	31.67	do	Do.
North watchhouse		16	44.40		55	09.49	do	Do.
Norwich church		32	57.64		05	46.78	do	Do.
Noyes		18	59.61		20	33.18	do	Do.
Ogden		23	48.29		05	24.44	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Orange	41	17	58.04	72	57	54.16	C. & G. S	Rept. '88.
Oyster Point		16	58.47		55	48.98	do	Do.
Oyster River Point		14	02.20		58	33.11	do	Do.
Paddock		16	25.92		34	13.68	do	Do.
Page		19	22.92		48	11.92	do	Do.
Paphro		28	40.41		31	30.35	do	Do.
Park church		32	07.87		04	55.05	do	Do.
Peak		57	32.48		44	24.02	G. S	Bull. 122.
Peck street		19	02.44		53	19.01	C. & G. S	Rept. '88.
Penfield Hill		34	54.05		34	29.77	do	Do.
Pettipaug spire		21	05.94		24	53.38	do	Do.
Pilgrim		19	49.60		20	27.46	do	Do.
Pine		21	59.66		58	25.68	do	Do.
Hill		36	37.64		32	11.98	do	Do.
Island		20	26.14		20	50.95	do	Do.
Street		18	47.78		53	16.56	do	Do.
Pinnacle		18	58.65		51	00.62	do	Do.
Plant Hill		16	39.10		50	29.84	do	Do.
Pole		27	14.52		07	41.57	do	Do.
Pond Lily Paper Mill, chimney		20	06.59		58	35.00	do	Do.
Pond Rock		17	40.04		51	24.46	do	Do.
Poorhouse flagstaff		21	08.51		06	41.80	do	Do.
Poplar		16	30.49		50	22.65	do	Do.
Poplar, 2 (1882)		16	30.47		50	22.65	do	Do.
Portland:								
White steeple		34	53.00		38	03.12	do	Do.
Congregational church		35	28.58		37	29.55	do	Do.
Schneider's factory smokestack		34	14.78		37	45.68	do	Do.
Post		13	22.33		59	40.60	do	Do.
Post Hill		40	15.15		20	19.64	G. S	Bull. 122.
Prindle		16	05.12		59	32.63	C. & G. S	Rept. '88.
Prospect church spire		30	07.69		58	41.88	do	Do.
Quaker		22	46.37		06	26.05	do	Do.
Quarry		24	26.72		25	17.11	do	Do.
Do		15	26.37		43	59.37	do	Do.
Quartz Hill		22	00.41		59	41.37	do	Do.
Rabbit Rock		20	31.63		51	12.19	do	Do.
Red and White		17	07.05		53	49.07	do	Do.
Road		24	18.51		56	40.25	do	Do.
Robinson Hill		47	43.61		04	48.29	G. S	Bull. 122.
Rock		31	10.98		04	13.18	C. & G. S	Rept. '88.
Rocky Ledge		18	30.73		15	01.16	do	Do.
Rogers, Smith & Co., cupola		18	09.46		54	38.76	do	Do.
Round Hill House		17	41.00		58	23.73	do	Do.
Sachem Head		16	58.58		43	30.78	do	Do.
Salmon		28	19.33		28	00.52	do	Do.
Sandford (1839)		28	07.64		57	13.78	do	Do.
Sandford Az. Station (1862)		27	42.80		56	59.30	do	Do.
Sandford Lat. Station (1862)		27	43.19		56	59.85	do	Do.
Sandy Point		16	04.16		55	35.10	do	Do.
Saybrook:								
Beacon (1882-83)		16	07.50		20	18.70	do	Do.
Light-house (1835-36)		16	17.65		20	36.94	do	Do.
Breakwater light-house (1886)		15	47.69		20	35.45	do	Do.
Congregational church (1861-1883)		17	12.20		22	32.29	do	Do.
Light-house (1861-1886)		16	17.39		20	36.86	do	Do.
Schoolhouse		30	54.32		04	32.55	do	Do.
Schoolhouse Hill		39	31.32		40	52.91	do	Do.
Selden		24	20.24		24	02.76	do	Do.
Selden Neck		23	43.05		24	54.72	do	Do.
Selden North		30	50.16		31	30.07	do	Do.
Setauket		19	36.49		46	32.11	do	Do.
Shailerville, Baptist church		27	55.48		28	47.96	do	Do.
Shaler		27	47.93		29	00.93	do	Do.
Shell Heap		18	43.58		52	58.94	do	Do.
Shipman		40	16.02		38	14.37	do	Do.
Simpson		37	58.08		36	47.82	do	Do.
Slate Hill		22	28.22		58	52.19	do	Do.
Slaughterhouse, east cupola		19	17.26		53	33.27	do	Do.
Smith		30	32.05		30	55.32	do	Do.
Smith Landing		29	07.76		30	26.30	do	Do.
Soapstone		57	32.50		24	49.30	G. S	Bull. 122.
South Pond Rock		17	05.89		51	49.89	C. & G. S	Rept. '88.
Southwest Ledge, light-house (1875-1882).		14	04.14		54	45.08	do	Do.
Sperry		21	06.84		59	14.60	do	Do.
Spink Hill		16	37.70		50	58.79	do	Do.
Steens		37	19.70		40	47.26	do	Do.
Stone Hill		19	54.15		24	11.31	do	Do.
Storr Monument		48	52.51		15	33.98	do	Do.
St. Francis Orphan Asylum, cupola		19	43.78		55	07.62	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Stony Creek	41	16	23.30	72	45	21.29	C. & G. S	Rept. '88.
Sugarloaf		22	31.86		43	54.97	do	Do.
Swan Hill		30	09.02		33	31.89	do	Do.
Sweet Hill		40	15.88		13	49.55	G. S	Bull. 122.
Talcott		48	41.64		47	57.19	C. & G. S	Rept. '88.
Taylor		40	19.05		35	25.38	do	Do.
Telegraph		17	09.92		55	52.59	do	Do.
Telegraph rod		18	56.81		53	14.72	do	Do.
Thayer		31	55.85		35	07.14	do	Do.
Thompson		19	42.10		49	58.20	do	Do.
Tory		31	04.44		04	05.33	do	Do.
Town Post		15	27.60		43	54.11	do	Do.
Tryon		32	40.58		37	37.73	do	Do.
Tulip tree		21	47.87		54	00.68	do	Do.
Tuxis Island		15	57.89		36	08.32	do	Do.
Tuxis Island, 2 (1882)		15	57.09		36	06.35	do	Do.
Two Tree Island		17	40.82		09	11.98	do	Do.
Two Tree Island, 2 (1882)		17	39.16		09	11.03	do	Do.
Two Tree Island House		17	40.18		09	11.37	do	Do.
Uncas Hill		28	14.90		05	27.62	do	Do.
Uncasville church		26	17.86		06	27.17	do	Do.
Upper Pole Hill		27	14.38		07	41.13	do	Do.
Vinegar Hill		25	27.37		03	21.53	do	Do.
Wadsworth tower (1875)		49	25.60		47	56.82	do	Do.
Wahginicut		23	43.60		25	45.92	do	Do.
Walden Island		28	06.55		04	08.33	do	Do.
Walkley		29	42.40		32	02.09	do	Do.
Wallingford church spire		27	15.75		49	08.42	do	Do.
Watch House		15	14.99		40	39.13	do	Do.
Water		17	20.00		55	40.34	do	Do.
West, 1 (1869)		23	28.90		05	45.30	do	Do.
West, 2 (1869)		24	04.40		05	55.66	do	Do.
West, 3 (1869)		24	26.68		05	54.99	do	Do.
Westbrook, Congregational church (1861-1882).		17	10.64		27	00.73	do	Do.
Westfield		33	31.17		42	34.15	do	Do.
West Haven spire (1833)		16	17.67		57	02.98	do	Do.
West Haven:								
Key Works, chimney		16	46.26		56	25.12	do	Do.
Congregational church (1876)		16	17.48		57	01.88	do	Do.
West Peak		33	34.90		50	38.78	G. S	Bull. 122.
West Rock		19	56.42		57	42.61	C. & G. S	Rept. '88.
West Rock (1882)		15	12.75		32	01.71	do	Do.
West Rock, 2 (1871)		19	56.42		57	42.00	do	Do.
West Rock North		22	58.88		57	44.84	do	Do.
West Rock North, 2 (1875)		23	21.94		57	34.93	do	Do.
West Rock Ridge		25	07.75		57	18.83	do	Do.
West Side church		31	19.35		04	58.70	do	Do.
Westville		19	35.65		58	16.80	do	Do.
Methodist Episcopal church		19	42.80		57	41.27	do	Do.
Wethersfield:								
Flagstaff (1875)		42	45.90		39	10.97	do	Do.
White Congregational church		42	46.70		39	09.60	do	Do.
Williams		21	18.95		31	09.57	do	Do.
Dock		21	37.88		23	28.60	do	Do.
Willow		29	44.08		04	28.80	do	Do.
Winchester Hill		19	28.04		55	18.96	do	Do.
Wire works		17	56.08		53	43.65	do	Do.
Yale College, middle spire		18	30.12		55	44.46	do	Do.
Yale Observatory:								
Center peg		19	28.48		55	19.16	do	Do.
East dome apex		19	28.48		55	18.06	do	Do.
York Hill		24	32.06		55	09.79	do	Do.
	41°-42°			73°-74°				
Adams	41	09	03.40	73	19	36.48	do	Do.
Americus, tower of Indian Harbor hotel.		00	37.27		37	09.36	do	Do.
Baker		18	29.29		31	20.28	do	Do.
Bald Hill		12	49.82		28	41.68	do	Bull. 122.
Bald Hill, 2 (1882)		12	49.82		28	41.71	do	Rept. '88.
Barn Hill		20	40.42		11	06.77	do	Do.
Beach Point		07	41.46		14	33.38	do	Do.
Bell Island		03	19.80		26	01.76	do	Do.
Benedict		04	24.94		28	23.74	do	Do.
Bennet		16	40.12		06	05.81	do	Do.
Blackburn		21	35.34		11	43.14	do	Do.
Black Rock (1833)		08	38.92		12	57.24	do	Do.
Black Rock, 2 (1834)		08	35.04		12	58.13	do	Do.
Black Rock:								
Light-house (1833-1835)		08	32.58		13	04.09	do	Do.
Beacon		07	14.36		13	03.79	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Nye's (R.) house, white chimney	41	21	54.53	71	46	28.12	C. & G. S	Rept. '85.
Paine		09	18.85		33	44.99	do	Do.
Pappoose Squaw		39	15.20		18	02.52	do	Do.
Pappoose Squaw, 2		39	15.20		18	02.45	do	Do.
Paradise Rock		30	05.51		15	45.50	do	Do.
Patience		39	33.47		21	24.58	do	Do.
Pawhungernock, church		30	20.06		50	25.46	do	Do.
Pawtucket:								
Spire		52	36.04		22	53.84	do	Do.
Dark spire		52	53.95		23	05.06	do	Do.
Pawtuxet		45	56.80		23	13.95	do	Do.
Borden		45	14.19		23	41.72	do	Do.
Beacon (1843)		45	35.56		22	50.95	do	Do.
Church spire		45	59.12		23	30.53	do	Do.
Peleg Tiff		23	18.75		48	40.42	do	Do.
Peirce:								
Barn		48	22.47		22	59.79	do	Do.
Barn cupola		25	34.08		28	50.74	do	Do.
Pine Hill		38	00.47		20	35.81	do	Do.
Pocasset		39	09.42		11	32.36	do	Do.
Point Judith		21	54.84		29	17.94	do	Do.
Light-house (1838)		21	39.88		28	54.73	do	Do.
Pojack		39	04.92		24	27.97	do	Do.
Pomham		46	42.15		21	28.04	do	Do.
Beacon (1843)		46	35.13		22	27.08	do	Do.
Poorhouse:								
Belfry		30	26.86		19	43.31	do	Do.
Northeast gable		35	21.98		24	50.76	do	Do.
Portsmouth, belfry		36	13.34		14	53.67	do	Do.
Portsmouth Grove, flagstaff		35	13.03		17	13.73	do	Do.
Potter's windmill shaft		30	56.30		22	28.66	do	Do.
Potter's (widow) barn		33	18.00		12	17.07	do	Do.
Potter's (A.) house chimney		30	29.90		21	38.60	do	Do.
Potter's (Dr.) house chimney		27	00.95		26	30.46	do	Do.
Prince		44	34.61		18	56.32	do	Do.
Prospect Hill		49	44.64		24	20.85	do	Do.
Providence:								
Baptist church		49	38.92		24	32.12	do	Do.
Congregational church		49	12.90		24	50.78	do	Do.
High Street church		49	05.73		25	16.25	do	Do.
Unitarian church		49	27.89		24	19.99	do	Do.
Quaker College		50	00.56		23	56.34	do	Do.
Vitriol works chimney		49	49.56		25	21.92	do	Do.
Prudence		36	24.42		18	42.59	do	Do.
2 (1869)		36	22.23		18	41.81	do	Do.
Island, light-house (1861)		36	21.34		18	14.46	do	Do.
Island, light-house (1869)		36	28.93		18	30.35	do	Do.
South		34	44.45		19	32.96	do	Do.
Quaker		34	57.38		15	18.34	do	Do.
Quonochontaug		19	59.99		42	37.33	do	Do.
Quonsett		35	26.58		24	33.70	do	Do.
Quonsett, 2		35	16.90		24	23.02	do	Do.
Quonsett, 3 (1868)		35	17.03		24	23.20	do	Bull. 122.
Reynolds		33	45.55		26	52.10	do	Rept. '85.
Rocky Point		41	29.72		21	50.06	do	Do.
Hotel chimney		41	21.91		21	56.52	do	Do.
Rose Island		29	48.20		20	34.44	do	Do.
Flagstaff		29	47.52		20	34.30	do	Do.
Rumstick		42	24.05		18	07.76	do	Do.
Sable Point		46	02.38		22	06.14	do	Do.
Sakonnet Point		27	16.36		11	46.09	do	Do.
Sanders's (E.) house chimney		20	26.32		44	46.60	do	Do.
Sandford, mill cupola		33	05.93		26	53.50	do	Do.
Sandhill		21	40.62		42	17.39	do	Do.
Sandy Point		39	43.29		24	37.14	do	Do.
Schoolhouse chimney		32	18.25		22	33.32	do	Do.
Seventh-Day meetinghouse, north chimney.		23	36.04		36	30.00	do	Do.
Shannock		28	05.19		38	21.49	do	Do.
Shaw's (Peter) barn cupola		29	14.50		08	45.72	do	Do.
Sherman		30	16.94		30	56.19	G. S	Bull. 122.
Sherman		30	16.94		30	56.02	C. & G. S	Rept. '85.
Sherman's (J. P.) house center chimney.		23	25.18		31	45.62	do	Do.
Sherman, house chimney		33	47.42		22	24.25	do	Do.
Signal flag		35	32.16		25	42.20	do	Do.
Simmons		29	32.29		09	34.21	do	Do.
Simmons, 2		29	32.08		09	34.66	do	Do.
Slate		32	21.01		15	59.64	do	Do.
Slate Hill, flagstaff (1869)		32	22.15		15	56.41	do	Do.
Smith, barn cupola		36	00.02		25	23.04	do	Do.

RHODE ISLAND—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	71°-72°		
South Portsmouth:	° ′ ″	° ′ ″		
Episcopal church tower	41 32 50.30	71 15 42.34	C. & G. S	Rept. '85.
Union church tower	33 30.18	15 21.90	do	Do.
South Rock	34 26.66	25 03.67	do	Do.
Spar Island	41 17.40	13 14.68	do	Do.
Spencer	40 43.26	29 40.68	do	Do.
Spencer (2), Warwick	40 38.87	29 49.30	do	Bull. 122.
Stargut Island, house, north gable	47 10.00	22 55.92	do	Rept. '85.
Stevens	44 44.13	22 56.05	do	Do.
Sugarloaf Hill	26 04.96	30 40.02	do	Do.
Tefft:				
Barn cupola	31 32.92	25 34.92	do	Do.
House chimney	28 01.34	27 37.94	do	Do.
Telegraph	27 47.83	20 11.63	do	Do.
Telegraph, 2	27 47.28	20 11.61	do	Do.
Tiff	27 48.56	32 15.70	do	Bull, 122.
Tiverton, cupola	37 30.25	12 50.91	do	Rept. '85.
Topographical pole, near post road	23 41.82	35 54.60	do	Do.
Topographical pole, 3	23 17.94	35 17.72	do	Do.
Topographical pole, 4	23 59.28	32 40.78	do	Do.
Topographical pole, 6	24 00.68	33 31.32	do	Do.
Tourtellot, Gloucester	53 40.34	39 16.48	do	Bull. 122.
Tower Hill, church	28 02.85	27 35.23	do	Rept. '85.
Toweset	41 59.23	14 33.74	do	Do,
Toweset Neck (Borden)	42 45.02	13 36.28	do	Do.
Vaughn, house cupola	34 25.62	27 45.68	do	Do.
Village Hill	20 54.17	44 59.29	do	Do.
Vue de l'Eau Hotel	47 15.82	22 05.09	do	Do.
Wakefield:				
Flagstaff	26 05.03	30 40.05	do	Do.
Church, gray spire	26 25.58	29 50.95	do	Do.
Church, white spire	26 24.25	30 11.06	do	Do.
Warren:				
Spire	43 48.47	17 04.14	do	Do.
Methodist spire	43 48.78	17 02.72	do	Do.
Beacon (1863)	42 48.74	17 37.24	do	Do.
Warwick beacon (1843)	39 25.02	23 36.17	do	Do.
Warwick light-house (1863)	40 01.43	22 43.28	do	Do.
Warwick Neck	41 21.10	22 49.72	do	Do.
Watch Hill	18 49.93	51 17.20	do	Do.
Light-house	18 14.19	51 32.43	do	Do.
Watson, house chimney	28 22.37	26 05.70	do	Do.
Weaver, Coventry	39 37.21	39 49.84	do	Bull. 122.
Weeden	22 50.89	33 15.24	do	Rept. '85.
Well Hill	25 56.65	45 15.92	do	Do.
West	38 44.42	15 42.00	do	Do.
West Island, New York Club flagstaff (1869).	27 00.81	11 59.03	do	Do.
Westerly	21 59.88	40 52.84	do	Do.
Wharton's (D.) house, east chimney	24 56.65	27 16.49	do	Do.
White House:				
West chimney	23 20.46	29 18.66	do	Do.
North chimney	40 46.09	27 04.36	do	Do.
Whitman	40 33.89	27 19.36	do	Do.
Wickford	34 30.54	28 02.69	do	Do.
Academy	34 06.68	27 21.19	do	Do.
Baptist church	34 19.58	27 05.35	do	Do.
Light-house (1868)	34 15.92	26 22.59	do	Do.
Spire	34 23.40	27 00.02	do	Do.
Wilbur	29 29.63	38 32.54	do	Do.
Windmill	29 24.36	11 02.56	do	Do.
Wilcox	21 23.20	43 59.86	do	Do.
Windmill	32 33.62	11 50.48	do	Do.
Windmill, 2 (1869)	32 33.56	11 50.51	do	Do.
Wing	35 23.22	11 10.35	do	Do.
Woonsocket	58 40.81	33 15.16	do	Bull. 122.
Yellow barn, cupola	22 31.40	37 26.60	do	Rept. '85.
Yellow house, chimney	43 41.87	19 23.20	do	Do.

CONNECTICUT.

	42°-43°	73°-74°		
	° ′ ″	° ′ ″		
Ball Peak, Mount Riga	42 00 43.33	73 27 57.84	C. & G. S	Rept. '88.
Connecticut line (Borden)	02 58.78	29 42.92	do	Do.
	41°-42°	71°-72°		
Atwoods, machine works cupola	41 19 49.32	71 54 26.23	do	Do.
Box Hill	47 59.79	27 21.40	do	Bull. 122,

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			71°-72°				
	°	′	″	°	′	″		
Chapman Hill	41	29	32.28	71	51	40.57	C. & G. S	Bull. 122.
Eels Hill, 2		22	49.87		51	04.85	do	Rept. '85.
Frost		20	57.57		51	03.25	do	Rept. '88.
Grant Hill		25	25.17		54	06.05	do	Do.
Jesse Main		26	31.63		49	15.00	do	Do.
Lantern Hill		27	37.93		56	40.83	do	Do.
Morgan Point, light-house (1874-1886)		18	59.43		59	23.67	do	Do.
Mount Riga (on Ball Peak)		00	43.33		27	57.84	do	Rept. '85.
Noank, spire (1882)		19	33.76		59	13.14	do	Do.
North Stonington		25	59.53		51	20.72	do	Do.
Northeast corner of Connecticut (Borden).		01	24.82		48	04.20	do	Do.
Palmer		21	37.29		55	41.92	do	Rept. '88.
Portersville, spire (1835)		21	14.80		58	24.87	do	Do.
Powkhungemock church (1838)		30	20.06		50	25.46	do	Do.
Quacatog		23	15.29		56	58.57	do	Do.
Ram Island:								
Hotel flagstaff		18	40.34		58	46.45	do	Do.
Reef Spindle (1835)		18	23.16		58	29.42	do	Do.
Road Meetinghouse (1838)		22	23.44		54	51.18	do	Do.
Sandford		27	42.80		56	59.30	do	Rept. '85.
Stonington:								
Meetinghouse (1835)		20	12.24		54	21.08	do	Rept. '88.
Harbor, light-house (1873-1886)		19	42.72		54	21.59	do	Do.
Walnut Hill		25	14.80		54	35.66	do	Do.
Wamposset		19	44.65		55	16.93	do	Do.
Wilcox, fish works, brick chimney		19	59.45		57	13.04	do	Do.
	41°-42°			72°-73°				
Allen	41	17	40.30	72	58	23.88	do	Do.
Arnold Quarry		28	26.06		30	28.54	do	Do.
Avery Hill		28	02.99		02	58.71	do	Do.
Avery Hill, 2		20	21.52		04	05.25	do	Do.
Avery Point		18	57.59		03	52.58	do	Do.
Avery Point, 2 (1882)		18	57.02		03	52.68	do	Do.
Ayer		19	55.92		21	38.38	do	Do.
Bailey		22	51.64		04	56.93	do	Do.
Bald Hill		58	25.89		11	55.03	do	Bull. 122.
Do		27	43.10		25	06.86	do	Rept. '88.
Baldwin		24	06.00		04	40.25	do	Do.
Barker		15	15.84		48	34.22	do	Do.
Bartlett		14	54.10		42	44.85	do	Do.
Beacon		18	48.03		03	58.98	do	Do.
Hill		17	34.65		24	08.85	do	Do.
Hill, 3 (1882)		17	34.38		24	09.32	do	Do.
Beckwith		21	12.50		21	23.04	do	Do.
Bethany:								
Church spire		25	30.92		59	47.33	do	Do.
South		23	34.15		58	03.90	do	Do.
Bigelow's house, chimney		18	09.63		54	04.21	do	Do.
Bill Hill		20	11.29		59	08.35	do	Do.
Block Point		17	09.68		12	19.75	do	Do.
Block Point, 2 (1882)		17	11.78		12	17.37	do	Do.
Bluff Point		18	53.97		02	04.97	do	Do.
Bog Hole Hill		18	49.74		18	56.90	do	Do.
Bog Hole Hill, 2 (1861)		18	49.74		18	56.95	do	Do.
Bolles Hill		27	49.24		04	43.04	do	Do.
Book Hill		22	06.53		24	47.38	do	Do.
Boulder		14	34.79		42	21.46	do	Do.
Bradley		17	14.20		49	28.04	do	Do.
Brainerd		29	18.49		31	35.95	do	Do.
Branford, Congregational church spire (1876).		16	52.22		48	40.61	do	Do.
Branford Reef, beacon (1881-1882)		13	16.78		48	20.68	do	Do.
Brethren		24	53.18		55	48.69	do	Do.
Brewster's Factory cupola		18	09.46		54	38.72	do	Do.
Bridge		17	33.28		55	59.19	do	Do.
Broadway church		31	34.05		04	33.65	do	Do.
Brockway		23	23.64		23	18.73	do	Do.
Brooks		25	24.26		25	42.99	do	Do.
Browning		25	05.54		06	23.63	do	Do.
Buckingham		22	56.35		23	47.90	do	Do.
C		16	14.33		54	21.20	do	Do.
Camp Hill		16	30.41		34	13.41	do	Do.
Canal Dock		17	38.30		54	52.73	do	Do.
Case		22	31.63		53	32.34	do	Do.
Cedar		31	08.33		05	25.87	do	Do.
Do		22	41.98		23	40.05	do	Do.
Do		17	43.14		57	44.57	do	Do.
Centerville, church		23	01.59		54	11.50	do	Do.
Champion House flagstaff		27	42.76		27	53.32	do	Do.
Chapin		18	01.01		06	45.28	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	72°-73°		
	° ′ ″	° ′ ″		
ston, cupola	41 31 41.22	72 04 50.63	C. & G. S	Rept. '88.
cal works ventilator	16 07.90	54 07.34	do	Do.
re, church spire	29 52.78	54 12.18	do	Do.
r:				
nding	24 50.52	25 45.96	do	Do.
ire	24 04.64	27 15.16	do	Do.
ut, 1 (1875)	21 56.86	57 05.62	do	Do.
ut, 2 (1875)	23 12.86	55 28.34	do	Do.
ut Hill	31 27.38	25 53.56	do	Do.
Point	14 00.32	58 43.15	do	Do.
n, church spire (1882)	16 39.89	31 38.74	do	Do.
eld Point	15 42.21	23 14.28	do	Do.
eld Point, 2 (1882)	15 42.48	23 14.73	do	Do.
	24 38.76	26 52.80	do	Do.
	17 55.09	50 58.03	do	Do.
r stone	24 03.62	05 27.44	do	Do.
ill	17 44.40	32 29.65	do	Do.
oint	24 32.33	05 33.94	do	Do.
Bar	17 06.14	54 13.95	do	Do.
ell, Congregational church	35 48.75	38 46.76	do	Do.
River spire	23 12.14	26 04.78	do	Do.
man	25 06.94	55 42.34	do	Do.
	17 01.99	56 16.54	do	Do.
	22 27.19	24 47.58	do	Do.
tle	22 25.18	58 48.29	do	Do.
n, brick church, spire	18 35.18	53 26.31	do	Do.
Island	15 23.67	28 33.14	do	Do.
Island, 2 (1882)	15 23.91	28 33.26	do	Do.
aven:				
ire	18 35.20	53 26.33	do	Do.
cond Congregational church	18 27.90	53 08.81	do	Do.
er Island, light-house (1833-1882)	12 43.18	39 14.45	do	Do.
iberty pole	32 08.89	05 28.42	do	Do.
s	31 06.86	04 09.50	do	Do.
ck Hall, flagstaff	16 20.43	21 15.03	do	Do.
	18 57.92	21 56.98	do	Do.
, 2 (1861)	18 57.91	21 57.00	do	Do.
ouse	15 49.62	27 53.71	do	Do.
aff	31 01.07	04 53.78	do	Do.
	16 58.77	53 58.50	do	Do.
addam:				
ngregational church	28 49.29	26 48.97	do	Do.
iscopal church	27 37.70	27 33.73	do	Do.
artford, square steeple, green ds.	46 08.56	38 41.38	do	Do.
aven:				
gstaff (1875)	16 32.08	52 04.15	do	Do.
ire	16 41.82	52 19.72	do	Do.
ock	19 37.42	54 17.44	do	Do.
ock, 2 (1871)	19 42.43	54 26.32	do	Do.
ombe House, flagstaff	19 31.46	04 31.67	do	Do.
	21 51.48	22 27.20	do	Do.
(1861)	21 51.48	22 27.19	do	Do.
(1861)	21 52.97	22 24.74	do	Do.
ns	32 06.35	32 07.63	do	Do.
	20 33.36	23 49.09	do	Do.
ptist church	21 18.26	23 33.57	do	Do.
ngregational church	21 09.96	23 34.24	do	Do.
iscopal church (1861)	21 11.08	23 32.43	do	Do.
, 2 (1861)	20 33.33	23 49.09	do	Do.
s	17 47.40	54 07.40	do	Do.
ale, 2 (1874)	16 14.79	54 18.57	do	Do.
ill, 2 (1882)	20 47.82	00 40.65	do	Do.
rumbull, flagstaff (1882)	20 38.28	05 39.16	do	Do.
Wooster, 3 (1882)	16 55.92	53 35.12	do	Do.
Mile River, 2 (1882)	18 12.40	16 13.48	do	Do.
ius Brewery cupola	17 56.34	56 36.16	do	Do.
n	26 57.58	26 31.49	do	Do.
Head	25 35.82	53 59.06	do	Do.
n	17 57.65	06 47.94	do	Do.
y	55 57.08	53 18.88	G. S	Bull. 122.
Hill, church	23 45.56	17 16.50	C. & G. S	Rept. '88.
Bluff	19 20.44	21 05.84	do	Do.
s	17 52.84	36 51.65	do	Do.
Hummock	15 35.22	30 43.34	do	Do.
Rock	20 31.54	51 11.30	do	Do.
Hill	49 00.26	23 14.32	G. S	Bull. 122.
old	17 30.24	39 36.26	C. & G. S	Rept. '88.
Hill	22 38.27	04 54.20	do	Do.
Long Point	18 26.80	00 21.29	do	Do.
Long Point, 2 (1882)	18 25.09	00 19.93	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-78°				
	°	′	″	°	′	″		
Groton Monument	41	21	18.02	72	04	47.45	C. & G. S.	Rept. '88.
Grove		19	02.97		52	57.23	do	Do.
Guard House Point, chimney		15	51.14		22	04.12	do	Do.
Haddam:								
Academy		28	44.81		30	59.76	do	Do.
Congregational church		28	45.82		30	56.05	do	Do.
Court-house		28	50.68		31	00.62	do	Do.
Haddam Neck		28	55.33		29	28.36	do	Do.
Congregational church		31	47.50		32	13.46	do	Do.
Methodist church		30	54.47		30	53.26	do	Do.
Flag		29	37.60		30	30.18	do	Do.
Hadlyme, church cupola		25	53.58		24	21.36	do	Do.
Hamburg Cove		22	36.66		22	21.00	do	Do.
Hamden Methodist church		21	11.38		55	53.14	do	Do.
Hammonasset, hotel chimney		16	17.35		35	10.39	do	Do.
Hammonasset, 2 (1882)		14	55.84		32	40.59	do	Do.
Harrison		18	00.48		49	45.16	do	Do.
Hartford:								
South Congregational church		45	34.82		40	33.35	do	Do.
Arsenal flagstaff		46	51.85		40	34.00	do	Do.
Colt's factory		45	24.28		39	48.90	do	Do.
Old State House cupola		45	58.03		40	23.38	do	Do.
Windsor avenue church		46	56.74		40	33.74	do	Do.
Hatchett Point		16	58.81		15	43.53	do	Do.
Hatchett Point, 2 (1882)		17	03.53		15	45.75	do	Do.
Hayden Point		20	37.22		22	38.52	do	Do.
Hemlock		22	27.28		59	03.64	do	Do.
Hemmingway		18	58.19		52	12.37	do	Do.
Hen and Chickens beacon (1882)		15	12.16		24	18.33	do	Do.
Higganum:								
Congregational church		29	51.13		33	20.29	do	Do.
Methodist church		29	54.66		33	49.49	do	Do.
High Hill		20	37.57		37	41.95	do	Do.
Highlands		15	56.18		38	57.53	do	Do.
High Rock		24	18.25		56	07.91	do	Do.
Hillhouse		19	40.61		59	48.57	do	Do.
Hillside		22	52.58		57	57.35	do	Do.
Hoadley Neck		15	27.53		44	10.04	do	Do.
Hogshead Point		16	10.60		38	15.26	do	Do.
Holt		25	41.32		27	29.89	do	Do.
Honey Hill		23	49.83		21	34.38	do	Do.
Horse Pond		17	36.20		35	20.92	do	Do.
Horse, cupola of house		14	39.86		45	31.03	do	Do.
Hotchkiss		23	43.87		58	53.50	do	Do.
Howard, 1 (1876)		24	31.72		52	18.81	do	Do.
Howard, 2 (1877)		24	51.14		52	33.05	do	Do.
Huddenston		26	57.06		58	24.78	do	Do.
Hungry Hill		18	49.90		41	33.02	do	Do.
Ives cupola		18	31.69		52	52.00	do	Do.
Indian Neck		15	23.82		49	19.76	do	Do.
Insane asylum, northwest chimney		33	08.02		37	50.08	do	Do.
Jail Hill		31	41.16		04	49.15	do	Do.
Jeremy:								
North		16	13.51		56	03.18	do	Do.
South		15	39.47		56	02.96	do	Do.
Jewett		18	46.91		58	22.14	do	Do.
Joe Post light (1861)		23	20.35		25	05.28	do	Do.
Johnny Cake		45	12.79		59	41.01	G. S.	Bull. 122.
Jones		27	59.34		27	32.46	C. & G. S.	Rept. '88.
Do		15	37.80		58	25.79	do	Do.
Jordan, church tower		18	31.00		07	42.35	do	Do.
Joshua Rock		22	51.84		22	37.80	do	Do.
Kelsey Clinton		15	24.44		30	27.65	do	Do.
Kelsey Westbrook		16	27.00		25	28.46	do	Do.
Kongscut		41	44.35		30	10.15	do	Do.
Lancrofts, cupola		18	05.15		53	17.68	do	Do.
Lay Hill		16	58.26		18	02.04	do	Do.
Lay Hill, 2 (1861)		16	58.20		18	02.06	do	Do.
Lay Hill, 3 (1882)		16	57.93		18	01.84	do	Do.
Lebanon		26	26.56		59	38.96	do	Do.
Ledge		25	07.39		05	17.74	do	Do.
Lewis		19	14.73		12	03.15	do	Do.
Lewis Grove		16	16.03		29	08.62	do	Do.
Locust		25	02.22		27	17.72	do	Do.
Long Hill		26	45.49		30	24.97	do	Do.
Do		17	26.35		30	47.08	do	Do.
Do		24	08.31		53	09.57	do	Do.
Lord		21	30.88		20	47.42	do	Do.
Lower Pole Hill		27	11.69		07	31.19	do	Do.
Lyme, white Congregational church (1835-1883).		18	46.45		19	56.04	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Madison:								
Church spire (1838)	41	16	44.80	72	36	08.35	C. & G. S	Rept. '88.
Congregational church spire (1882)		16	47.90		36	12.79	do	Do.
Malicah		20	35.17		20	09.23	do	Do.
Manetuck		21	15.56		09	03.16	do	Do.
Manetuck, 2 (1882)		21	15.26		09	03.53	do	Do.
Mansfield		21	52.39		50	20.97	do	Do.
Mason		30	30.13		04	41.83	do	Do.
Maynard		26	10.51		04	14.49	do	Do.
Meeting House Hill		36	08.68		08	38.97	G. S	Bull. 122.
Menunketesuck		15	42.73		27	48.99	C. & G. S	Rept. '88
Merritt		24	23.65		56	30.69	do	Do.
Middletown:								
Catholic church		33	59.08		39	11.92	do	Do.
Indian Hill Cemetery, summer-house.		33	17.08		39	48.19	do	Do.
North Congregational church		33	36.59		39	05.42	do	Do.
South Congregational church		33	23.25		38	51.74	do	Do.
Wesleyan College chapel		33	20.72		39	23.04	do	Do.
Mill Rock		16	48.22		51	47.65	do	Do.
Millstone Point		18	18.92		09	54.44	do	Do.
House, west chimney		18	30.40		10	08.21	do	Do.
Mohican:								
Church spire (1838)		28	23.88		05	55.31	do	Do.
Church spire (1874)		28	23.90		05	55.40	do	Do.
Montowese church		20	55.49		51	45.80	do	Do.
Morgan Point		14	32.70		53	39.53	do	Do.
Moose Hill, New Haven		18	22.56		44	34.18	do	Do.
Moodus		31	13.47		27	32.64	do	Do.
Mound		30	32.65		05	13.43	do	Do.
Mount Carmel		25	51.80		53	25.64	do	Do.
Mount Ephraim		27	47.45		54	56.64	do	Do.
Mount Parnassus		28	03.61		24	40.54	do	Do.
Mount Prospect		28	22.70		58	16.34	do	Do.
Mulberry Point		15	37.52		40	55.47	do	Do.
Murdock		17	10.50		28	20.94	do	Do.
Murdock, 2 (1882)		17	06.83		28	21.73	do	Do.
New England Cement Works, smoke-stack.		22	36.18		58	39.97	do	Do.
New Haven:								
First Congregational church		18	34.78		53	38.15	do	Do.
Baptist church		18	33.50		53	23.82	do	Do.
Light-house (1833-1882)		14	56.40		54	15.13	do	Do.
City Hall		18	26.57		55	29.87	do	Do.
Almshouse cupola		18	55.57		57	08.48	do	Do.
Scientific School, observatory tower.		18	42.77		55	32.63	do	Do.
St. Paul's Episcopal church, southwest spire.		18	13.74		55	13.86	do	Do.
St. Patrick's church		18	30.72		54	42.41	do	Do.
Grace church		18	25.50		53	57.08	do	Do.
South church		17	53.48		55	52.88	do	Do.
Custom-House Square, flagstaff		18	02.82		55	26.63	do	Do.
Schoolhouse cupola		18	35.19		53	26.32	do	Do.
Long Wharf light-house (1873)		17	33.82		54	56.49	do	Do.
New London:								
First Congregational church (1882).		21.	18.23		05	50.38	do	Do.
Second Congregational church (1882).		21	26.34		06	06.30	do	Do.
Light-house (1835-1886)		18	59.99		05	24.68	do	Do.
Niantic, spire		19	39.00		11	35.04	do	Do.
Nickerson		23	53.85		19	39.56	do	Do.
No Name		26	41.35		57	30.62	do	Do.
North		17	35.88		54	15.85	do	Do.
North Glastonbury, Congregational church.		42	31.86		36	31.92	do	Do.
North Guilford church spire		22	05.84		43	39.44	do	Do.
North Haven church spire		23	12.97		51	42.66	do	Do.
North Hill		22	36.82		49	18.43	do	Do.
North Killingworth, Congregational church (1836-1882).		21	47.07		33	58.07	do	Do.
North Pond Rock		19	00.52		50	17.48	do	Do.
North Quinnipiac		19	28.71		53	20.77	do	Do.
North Sheffield College:								
Larger observatory in college grounds.		18	47.00		55	30.89	do	Do.
South chimney lightning rod		18	45.96		55	31.67	do	Do.
North watchhouse		16	44.40		55	09.49	do	Do.
Norwich church		32	57.64		05	46.78	do	Do.
Noyes		18	59.61		20	33.18	do	Do.
Ogden		23	48.29		05	24.44	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	72°-73°		
	° ′ ″	° ′ ″		
Orange	41 17 58.04	72 57 54.16	C. & G. S	Rept. '88.
Oyster Point	16 58.47	55 48.98	do	Do.
Oyster River Point	14 02.20	58 33.11	do	Do.
Paddock	16 25.92	34 13.68	do	Do.
Page	19 22.92	48 11.92	do	Do.
Paphro	28 40.41	31 30.35	do	Do.
Park church	32 07.87	04 55.05	do	Do.
Peak	57 32.48	44 24.02	G. S	Bull. 122.
Peck street	19 02.44	53 19.01	C. & G. S	Rept. '88.
Penfield Hill	34 54.05	34 29.77	do	Do.
Pettipaug spire	21 05.94	24 53.38	do	Do.
Pilgrim	19 49.60	20 27.46	do	Do.
Pine	21 59.66	58 25.68	do	Do.
Hill	36 37.64	32 11.98	do	Do.
Island	20 26.14	20 50.95	do	Do.
Street	18 47.78	53 16.56	do	Do.
Pinnacle	18 58.65	51 00.62	do	Do.
Plant Hill	16 39.10	50 29.84	do	Do.
Pole	27 14.52	07 41.57	do	Do.
Pond Lily Paper Mill, chimney	20 06.59	58 35.00	do	Do.
Pond Rock	17 40.04	51 24.46	do	Do.
Poorhouse flagstaff	21 08.51	06 41.80	do	Do.
Poplar	16 30.49	50 22.65	do	Do.
Poplar, 2 (1882)	16 30.47	50 22.65	do	Do.
Portland:				
White steeple	34 53.00	38 03.12	do	Do.
Congregational church	35 28.58	37 29.55	do	Do.
Schneider's factory smokestack	34 14.78	37 45.68	do	Do.
Post	13 22.33	59 40.60	do	Do.
Post Hill	40 15.15	20 19.64	G. S	Bull. 122.
Prindle	16 05.12	59 32.63	C. & G. S	Rept. '88.
Prospect church spire	30 07.69	58 41.88	do	Do.
Quaker	22 46.37	06 26.05	do	Do.
Quarry	24 26.72	25 17.11	do	Do.
Do	15 26.37	43 59.37	do	Do.
Quartz Hill	22 00.41	59 41.37	do	Do.
Rabbit Rock	20 31.63	51 12.19	do	Do.
Red and White	17 07.05	53 49.07	do	Do.
Road	24 18.51	56 40.25	do	Do.
Robinson Hill	47 43.61	04 48.29	G. S	Bull. 122.
Rock	31 10.98	04 13.18	C. & G. S	Rept. '88.
Rocky Ledge	18 30.73	15 01.16	do	Do.
Rogers, Smith & Co., cupola	18 09.46	54 38.76	do	Do.
Round Hill House	17 41.00	58 23.73	do	Do.
Sachem Head	16 58.58	43 30.78	do	Do.
Salmon	28 19.33	28 00.52	do	Do.
Sandford (1839)	28 07.64	57 13.78	do	Do.
Sandford Az. Station (1862)	27 42.80	56 59.30	do	Do.
Sandford Lat. Station (1862)	27 43.19	56 59.85	do	Do.
Sandy Point	16 04.16	55 35.10	do	Do.
Saybrook:				
Beacon (1882-83)	16 07.50	20 18.70	do	Do.
Light-house (1835-36)	16 17.65	20 36.94	do	Do.
Breakwater light-house (1886)	15 47.69	20 35.45	do	Do.
Congregational church (1861-1883)	17 12.20	22 32.29	do	Do.
Light-house (1861-1886)	16 17.39	20 36.86	do	Do.
Schoolhouse	30 54.32	04 32.55	do	Do.
Schoolhouse Hill	39 31.32	40 52.91	do	Do.
Selden	24 20.24	24 02.76	do	Do.
Selden Neck	23 43.05	24 54.72	do	Do.
Selden North	30 50.16	31 30.07	do	Do.
Setauket	19 36.49	46 32.11	do	Do.
Shailerville, Baptist church	27 55.48	28 47.96	do	Do.
Shaler	27 47.93	29 00.93	do	Do.
Shell Heap	18 43.58	52 58.94	do	Do.
Shipman	40 16.02	38 14.37	do	Do.
Simpson	37 58.08	36 47.82	do	Do.
Slate Hill	22 28.22	58 52.19	do	Do.
Slaughterhouse, east cupola	19 17.26	53 33.27	do	Do.
Smith	30 32.05	30 55.32	do	Do.
Smith Landing	29 07.76	30 26.30	do	Do.
Soapstone	57 32.50	24 49.30	G. S	Bull. 122.
South Pond Rock	17 05.89	51 49.89	C. & G. S	Rept. '88.
Southwest Ledge, light-house (1875-1882).	14 04.14	54 45.08	do	Do.
Sperry	21 06.84	59 14.60	do	Do.
Spink Hill	16 37.70	50 58.79	do	Do.
Steens	37 19.70	40 47.26	do	Do.
Stone Hill	19 54.15	24 11.31	do	Do.
Storr Monument	48 52.51	15 33.98	do	Do.
St. Francis Orphan Asylum, cupola	19 43.78	55 07.62	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			72°-73°				
	°	′	″	°	′	″		
Stony Creek	41	16	23.30	72	45	21.29	C. & G. S	Rept. '88.
Sugarloaf		22	31.86		43	54.97	do	Do.
Swan Hill		30	09.02		33	31.89	do	Do.
Sweet Hill		40	15.88		13	49.55	G. S	Bull. 122.
Talcott		48	41.64		47	57.19	C. & G. S	Rept. '88.
Taylor		40	19.05		35	25.38	do	Do.
Telegraph		17	09.92		55	52.59	do	Do.
Telegraph rod		18	56.81		53	14.72	do	Do.
Thayer		31	55.85		35	07.14	do	Do.
Thompson		19	42.10		49	58.20	do	Do.
Tory		31	04.44		04	05.33	do	Do.
Town Post		15	27.60		43	54.11	do	Do.
Tryon		32	40.58		37	37.73	do	Do.
Tulip tree		21	47.87		54	00.68	do	Do.
Tuxis Island		15	57.89		36	08.32	do	Do.
Tuxis Island, 2 (1882)		15	57.09		36	06.35	do	Do.
Two Tree Island		17	40.82		09	11.98	do	Do.
Two Tree Island, 2 (1882)		17	39.16		09	11.03	do	Do.
Two Tree Island House		17	40.18		09	11.37	do	Do.
Uncas Hill		28	14.90		05	27.62	do	Do.
Uncasville church		26	17.86		06	27.17	do	Do.
Upper Pole Hill		27	14.38		07	41.13	do	Do.
Vinegar Hill		25	27.37		03	21.53	do	Do.
Wadsworth tower (1875)		49	25.60		47	56.82	do	Do.
Wahginicut		23	43.60		25	45.92	do	Do.
Walden Island		28	06.55		04	08.33	do	Do.
Walkley		29	42.40		32	02.09	do	Do.
Wallingford church spire		27	15.75		49	08.42	do	Do.
Watch House		15	14.99		40	39.13	do	Do.
Water		17	20.00		55	40.34	do	Do.
West, 1 (1869)		23	28.90		05	45.30	do	Do.
West, 2 (1869)		24	04.40		05	55.66	do	Do.
West, 3 (1869)		24	26.68		05	54.99	do	Do.
Westbrook, Congregational church (1861-1882).		17	10.64		27	00.73	do	Do.
Westfield		33	31.17		42	34.15	do	Do.
West Haven spire (1833)		16	17.67		57	02.98	do	Do.
West Haven:								
Key Works, chimney		16	46.26		56	25.12	do	Do.
Congregational church (1876)		16	17.48		57	01.88	do	Do.
West Peak		33	34.90		50	38.78	G. S	Bull. 122.
West Rock		19	56.42		57	42.61	C. & G. S	Rept. '88.
West Rock (1882)		15	12.75		32	01.71	do	Do.
West Rock, 2 (1871)		19	56.42		57	42.00	do	Do.
West Rock North		22	58.88		57	44.84	do	Do.
West Rock North, 2 (1875)		23	21.94		57	34.93	do	Do.
West Rock Ridge		25	07.75		57	18.83	do	Do.
West Side church		31	19.35		04	58.70	do	Do.
Westville		19	35.65		58	16.80	do	Do.
Methodist Episcopal church		19	42.80		57	41.27	do	Do.
Wethersfield:								
Flagstaff (1875)		42	45.90		39	10.97	do	Do.
White Congregational church		42	46.70		39	09.60	do	Do.
Williams		21	18.95		31	09.57	do	Do.
Dock		21	37.88		23	28.60	do	Do.
Willow		29	44.08		04	28.80	do	Do.
Winchester Hill		19	28.04		55	18.96	do	Do.
Wire works		17	56.08		53	43.65	do	Do.
Yale College, middle spire		18	30.12		55	44.46	do	Do.
Yale Observatory:								
Center peg		19	28.48		55	19.16	do	Do.
East dome apex		19	28.48		55	18.06	do	Do.
York Hill		24	32.06		55	09.79	do	Do.
	41°-42°			73°-74°				
Adams	41	09	03.40	73	19	36.48	do	Do.
Americus, tower of Indian Harbor hotel.		00	37.27		37	09.36	do	Do.
Baker		18	29.29		31	20.28	do	Do.
Bald Hill		12	49.82		28	41.68	do	Bull. 122.
Bald Hill, 2 (1882)		12	49.82		28	41.71	do	Rept. '88.
Barn Hill		20	40.42		11	06.77	do	Do.
Beach Point		07	41.46		14	33.38	do	Do.
Bell Island		03	19.80		26	01.76	do	Do.
Benedict		04	24.94		28	23.74	do	Do.
Bennet		16	40.12		06	05.81	do	Do.
Blackburn		21	35.34		11	43.14	do	Do.
Black Rock (1833)		08	38.92		12	57.24	do	Do.
Black Rock, 2 (1834)		08	35.04		12	58.13	do	Do.
Black Rock:								
Light-house (1833-1835)		08	32.58		13	04.09	do	Do.
Beacon		07	14.36		13	03.79	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
Booth	41	16	42.43	73	11	06.28	C. & G. S	Rept. '88.
Bradley		10	53.83		17	30.54	do	Do.
Bridgeport:								
Harbor light-house (1882)		09	24.18		10	49.38	do	Do.
Inner northeast beacon (1833–1882)		09	58.88		10	35.60	do	Do.
Outer southwest beacon (1833–1882)		09	47.01		10	45.86	do	Do.
Second Congregational church spire (1882).		10	32.60		11	24.26	do	Do.
First Congregational church spire (1882).		10	37.60		11	26.42	do	Do.
First Presbyterian church spire (1882).		10	29.30		11	42.32	do	Do.
Harbor light-house (1853)		09	26.26		10	48.40	do	Do.
Middle steeple (1833)		10	34.76		11	24.83	do	Do.
North steeple (1833)		10	37.64		11	26.53	do	Do.
St. Augustine Catholic church spire (1882).		10	48.70		11	45.00	do	Do.
South steeple (1833)		10	32.51		11	23.95	do	Do.
Brown		10	01.82		25	47.64	do	Do.
Brushy Ridge		09	24.29		29	00.90	do	Do.
Burns Point		12	37.34		03	01.45	do	Do.
Calf Pasture Island		04	56.36		23	03.57	do	Do.
Canal		05	58.33		22	26.19	do	Do.
Center Redding		19	00.62		22	57.91	do	Do.
Charles Island, poplar		11	28.16		03	18.96	do	Do.
Chestnut		14	13.50		14	14.61	do	Do.
Chestnut Tree Hill		26	26.53		05	42.48	do	Do.
Chimon Island (1834)		04	03.24		23	29.30	do	Do.
Chimon Island, 2 (1882)		04	04.78		23	29.37	do	Do.
Close		04	47.84		38	03.75	do	Do.
Cobble		46	37.15		30	04.53	do	Do.
Cockenoes		05	01.42		21	20.76	do	Do.
Cockenoes Island, 2 (1882)		05	01.40		21	21.08	do	Do.
Collins		26	20.28		00	44.90	do	Do.
Connecticut		57	28.35		29	37.59	do	Do.
Connecticut Monument		57	30.00		29	37.56	do	Do.
Copp Island (1834–1885)		03	34.41		23	15.48	do	Do.
Coram		17	52.72		05	04.11	do	Do.
Cronch		17	08.85		25	56.32	do	Do.
Cumpo (1834)		06	50.04		21	00.52	do	Do.
Cumpo, 2 (1882)		06	49.23		20	58.11	do	Do.
Danbury, Congregational church (1864).		23	39.87		27	11.87	do	Do.
Davenport		07	34.72		31	42.73	do	Do.
Dead Tree Hill		17	13.17		18	59.50	do	Do.
Dorlon's Hotel, cupola		05	13.21		24	07.70	do	Do.
Dye works, southwest chimney		02	52.30		30	15.60	do	Do.
East Bridgeport, Catholic church spire (1884).		10	54.55		10	44.72	do	Do.
Easton spire (1839)		15	01.63		18	10.59	do	Do.
Ellsworth		48	07.78		27	12.47	do	Do.
Fairfield		09	23.92		15	33.68	do	Do.
Congregational church spire (1882)		08	35.56		15	02.06	do	Do.
Episcopal church spire (1882)		08	32.58		15	02.89	do	Do.
Presbyterian church spire (1833)		08	35.99		15	01.57	do	Do.
Ferris, cupola of "Old Greenwich Pt. House."		01	04.14		33	49.71	do	Do.
Field Point		00	06.50		37	37.92	do	Do.
Fish Island		02	54.35		27	28.32	do	Do.
Frost Point		06	55.52		18	34.71	do	Do.
Frost Point, 2 (1882)		06	55.46		18	33.78	do	Do.
Good Hill		32	55.52		15	36.75	do	Bull. 122.
Goodridge		19	41.89		18	49.19	do	Rept. '88.
Goodsall		15	58.50		24	55.52	do	Do.
Gorham		11	00.29		23	45.68	do	Do.
Goshen Center Congregational church (1865).		49	54.11		13	30.74	do	Do.
Gould		10	58.50		16	38.38	do	Do.
Great Hill, east		21	53.66		07	01.36	do	Do.
Green Farms, spire (1834)		08	09.62		19	50.77	do	Do.
Green Ledge Spindle		02	36.35		25	22.57	do	Do.
Greenfield		11	32.29		17	18.69	do	Do.
Church spire (1882)		10	36.82		17	34.19	do	Do.
Church spire (1833)		10	37.06		17	34.21	do	Do.
Greenwich Point		00	09.90		34	17.40	do	Do.
Greenwich Point, 2 (1882)		00	14.20		34	26.13	do	Do.
Gunn		13	56.53		04	57.96	do	Do.
Handford		09	06.74		22	27.02	do	Do.
Hawley		19	17.46		14	55.50	do	Do.
Hickcox		23	12.43		00	13.53	do	Do.
Hickcox (1839–1876)		23	12.75		00	13.75	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
High Ridge	41	16	24.20	73	30	09.06	C. & G. S.	Rept. '88.
Hitchcock		48	04.49		29	42.13	do	Do.
Hobby		03	35.28		36	59.41	do	Do.
Hooper		24	56.46		00	03.97	do	Do.
Horseneck, First Congregational church spire.		02	07.19		37	24.64	do	Do.
Horseneck, spire (1833)		02	06.08		37	24.46	do	Do.
Hospital		11	21.21		10	00.76	do	Do.
Hunt		18	24.28		32	54.32	do	Do.
Ivy		52	18.50		13	27.93	do	Rept. '85.
Jackson		15	06.59		17	00.41	do	Rept. '88
Johnson		10	04.88		10	04.08	do	Do.
Kensies Point		07	33.24		16	22.52	do	Do.
Lambert		48	10.94		30	13.25	do	Do.
Litchfield:								
Congregational church (1865)		44	52.26		11	18.49	do	Do.
Episcopal church (1865)		44	46.21		11	19.29	do	Do.
Loaf Hill		19	34.70		29	55.06	do	Do.
Lockwood		05	34.61		29	04.16	do	Do.
Lone Chimney		09	18.30		13	05.11	do	Do.
Long Neck		02	11.10		28	40.88	do	Do.
Long Neck, 2 (1882)		02	10.41		28	41.85	do	Do.
McDonald		13	08.44		09	11.26	do	Do.
Mead (1864)		18	07.34		32	53.13	do	Do.
Merwin		14	09.09		19	57.60	do	Do.
Miles Fish Works chimney		12	07.60		02	18.20	do	Do.
Milford		13	26.43		01	15.51	do	Do.
Congregational spire (1833-1884)		13	36.63		03	33.03	do	Do.
Episcopal church spire		13	27.23		03	27.73	do	Do.
Old spire with gilt ball		13	37.46		03	25.97	do	Do.
Point		10	42.67		05	51.92	do	Do.
Mill Hill		08	49.37		16	42.32	do	Do.
Mohawk		49	16.80		17	49.50	G. S.	Bull. 122.
Monroe:								
Belfry (1839)		19	55.38		12	24.48	C. & G. S	Rept. '88.
Tall spire (1839)		19	58.84		12	26.90	do	Do.
Moose Hill, east		24	05.57		06	55.36	do	Do.
Moose Hill, Fairfield County		19	11.73		12	06.09	do	Do.
Mount Tom		41	36.43		16	25.54	do	Bull. 122.
Nash		06	04.80		25	41.60	do	Rept. '88.
Newton		25	51.86		02	04.58	do	Do.
Nichols		08	49.10		08	10.72	do	Do.
Norfield, spire (1834)		12	10.31		22	40.51	do	Do.
North Milford, spire		16	42.20		01	35.36	do	Do.
Norton		03	16.70		30	53.07	do	Do.
Norton Point		03	19.32		26	19.40	do	Do.
Norwalk, north spire (1834)		07	14.62		24	28.56	do	Do.
Norwalk Islands, light-house (1834)		02	55.43		25	10.52	do	Do.
Norwalk Islands, light-house (1882-1885).		02	55.74		25	10.53	do	Do.
Norwalk River beacon (1882)		04	23.70		24	22.10	do	Do.
Norwalk, south spire (1834)		07	07.66		24	30.78	do	Do.
Old Farms		14	53.06		09	18.82	do	Do.
Osborne		23	37.47		12	44.87	do	Do.
Palmer		03	40.87		34	06.19	do	Do.
Patrick		17	36.24		31	18.62	do	Do.
Pavement		11	37.34		17	17.35	do	Do.
Peck		22	54.11		03	30.47	do	Do.
Peet Hill		40	02.37		26	08.97	do	Do.
Penfield Reef, light-house (1882)		07	01.57		13	21.01	do	Do.
Picket Ridge		19	29.41		27	11.43	do	Do.
Pine Creek Point (1833)		07	06.34		15	42.24	do	Do.
Pine Creek Point, 3 (1882)		07	07.37		15	42.99	do	Do.
Pine Swamp Hill		21	09.10		16	29.21	do	Do.
Pond Point		12	41.24		00	38.20	do	Do.
Preston, stone church (1865)		40	37.16		22	22.82	do	Do.
Preston, white spire (1865)		41	05.78		18	42.98	do	Do.
Prospect Hill		58	45.11		23	06.28	do	Do.
Ram Island		03	32.83		24	12.52	do	Do.
Redding Ridge		18	11.10		21	12.32	do	Do.
Redding, spire (1839)		18	49.68		21	04.34	do	Do.
Ridgefield:								
Episcopal church (1865)		16	49.50		29	59.05	do	Do.
Presbyterian church (1839)		16	30.47		29	52.89	do	Do.
Riggs		24	44.15		07	48.73	do	Do.
Rock		00	06.57		37	41.22	do	Do.
Rockhouse Hill		23	04.94		08	22.13	do	Do.
Round Hill		06	13.17		40	25.79	do	Do.
Round Hill, 2 (1882)		06	13.02		40	26.23	do	Do.
Saugatuck		07	28.00		19	23.08	do	Do.
Scofield		08	20.92		34	52.98	do	Do.

CONNECTICUT—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
High Ridge	41	16	24.20	73	30	00.06	C. & G. S.	Rept. '88.
Hitchcock		48	04.49		29	42.13	do	Do.
Hobby		03	35.28		36	59.41	do	Do.
Hooper		24	56.46		00	03.97	do	Do.
Horseneck, First Congregational church spire.		02	07.19		37	24.64	do	Do.
Horseneck, spire (1833)		02	06.08		37	24.46	do	Do.
Hospital		11	21.21		10	00.76	do	Do.
Hunt		18	24.28		32	54.32	do	Do.
Ivy		52	18.50		13	27.93	do	Rept. '85.
Jackson		15	06.59		17	00.41	do	Rept. '88
Johnson		10	04.88		10	04.08	do	Do.
Kensies Point		07	33.24		16	22.52	do	Do.
Lambert		48	10.94		30	13.25	do	Do.
Litchfield:								
Congregational church (1865)		44	52.26		11	18.49	do	Do.
Episcopal church (1865)		44	46.21		11	19.29	do	Do.
Loaf Hill		19	34.70		29	55.06	do	Do.
Lockwood		05	34.61		29	04.16	do	Do.
Lone Chimney		09	18.30		13	05.11	do	Do.
Long Neck		02	11.10		28	40.88	do	Do.
Long Neck, 2 (1882)		02	10.41		28	41.85	do	Do.
McDonald		13	08.44		09	11.26	do	Do.
Mead (1864)		18	07.34		32	53.13	do	Do.
Merwin		14	09.09		19	57.60	do	Do.
Miles Fish Works chimney		12	07.60		02	18.20	do	Do.
Milford		13	26.43		01	15.51	do	Do.
Congregational spire (1833-1884)		13	36.63		03	33.03	do	Do.
Episcopal church spire		13	27.23		03	27.73	do	Do.
Old spire with gilt ball		13	37.46		03	25.97	do	Do.
Point		10	42.67		05	51.92	do	Do.
Mill Hill		08	49.37		16	42.32	do	Do.
Mohawk		49	16.80		17	49.50	G. S	Bull. 122.
Monroe:								
Belfry (1839)		19	55.38		12	24.48	C. & G. S	Rept. '88.
Tall spire (1839)		19	58.84		12	26.90	do	Do.
Moose Hill, east		24	05.57		06	55.36	do	Do.
Moose Hill, Fairfield County		19	11.73		12	06.09	do	Do.
Mount Tom		41	36.43		16	25.54	do	Bull. 122
Nash		06	04.80		25	41.60	do	Rept. '88
Newton		25	51.86		02	04.58	do	Do.
Nichols		08	49.10		08	10.72	do	Do.
Norfield, spire (1834)		12	10.31		22	40.51	do	Do.
North Milford, spire		16	42.20		01	35.36	do	Do.
Norton		03	16.70		30	53.07	do	Do.
Norton Point		03	19.82		26	19.40	do	Do.
Norwalk, north spire (1834)		07	14.62		24	28.56	do	Do.
Norwalk Islands, light-house (1834)		02	55.43		25	10.52	do	Do.
Norwalk Islands, light-house (1882-1885).		02	55.74		25	10.53	do	Do.
Norwalk River beacon (1882)		04	23.70		24	22.10	do	[illegible]
Norwalk, south spire (1834)		07	07.66		24	30.78	do	[illegible]
Old Farms		14	53.06		09	18.62	do	[illegible]
Osborne		23	37.47		12	44.67	do	[illegible]
Palmer		03	40.87		[illegible]	[illegible]	do	
Patrick		17	38.24		[illegible]	[illegible]	do	
Pavement		11	[illegible]		[illegible]	[illegible]	do	
Peck		[illegible]	[illegible]		[illegible]	[illegible]	do	
Peet Hill		[illegible]	[illegible]		[illegible]	[illegible]	do	
Penfield Reef, light-		[illegible]	[illegible]		[illegible]	[illegible]	do	
Picket Ridge		[illegible]	[illegible]		[illegible]	[illegible]	do	[illegible]
Pine Creek Point		[illegible]	[illegible]		[illegible]	[illegible]	do	[illegible]
Pine Creek Poi		[illegible]	[illegible]		[illegible]	[illegible]	do	[illegible]
Pine Swamp H		[illegible]	[illegible]		[illegible]	[illegible]	do	[illegible]
Pond Point		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
Prest		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	

CONNECTICUT—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42° ° ′ ″	73°-74° ° ′ ″		
Seaside Park, soldiers' monument	41 09 41.58	73 11 11.92	C. & G. S.	Rept. '88.
Sheffield Island	02 50.20	25 21.73	do	Do.
Sheffield, west	02 52.01	25 27.59	do	Do.
Sherwood	12 09.04	13 24.07	do	Do.
Shippan	01 32.23	31 10.65	do	Do.
Shippan Point	01 12.22	31 24.38	do	Do.
Old chimney	01 28.00	31 12.02	do	Do.
Skagerat	24 46.21	03 08.84	do	Do.
Southport:				
Congregational church spire (1882).	08 06.28	17 12.90	do	Do.
Episcopal Church spire (1882)	08 00.25	17 16.84	do	Do.
Inner beacon (1882)	07 33.45	17 15.45	do	Do.
Outer beacon (1882)	07 18.86	17 15.72	do	Do.
South Whitehall	19 12.91	07 56.23	do	Do.
Spindle	00 21.54	36 44.77	do	Do.
Stamford:				
Baptist church spire (1882)	03 18.68	32 21.29	do	Do.
Congregational church spire (1882).	03 08.94	32 24.22	do	Do.
Harbor, light-house (1882-1885)	00 49.21	32 34.74	do	Do.
Northeast spire (1834)	03 14.76	32 03.19	do	Do.
Southwest spire (1834)	03 12.78	32 21.98	do	Do.
Stanwick	06 33.32	36 51.06	do	Do.
Star	18 46.66	27 39.18	do	Do.
Stratford:				
Beacon (1881-1884)	09 47.11	06 14.89	do	Do.
Beacon (1833)	09 47.05	06 14.82	do	Do.
Congregational church spire (1884).	11 33.20	07 51.82	do	Do.
Episcopal church spire (1884)	11 18.68	07 50.06	do	Do.
Hill	13 08.36	09 10.79	do	Do.
Point	09 28.72	07 06.12	do	Do.
Point, light-house (1881-1885)	09 07.22	06 13.47	do	Do.
Point, light-house (1833)	09 07.24	06 13.18	do	Do.
Spire (1833)	11 19.44	07 50.17	do	Do.
Do	11 32.84	07 51.56	do	Do.
St. John	06 58.31	25 31.86	do	Do.
Summerville	20 32.78	03 28.56	do	Do.
Tashua	15 37.84	15 01.33	do	Do.
Church (1839)	17 13.31	15 38.87	do	Do.
Tavern Island	03 39.14	25 20.80	do	Do.
Flagstaff (1882)	03 39.01	25 20.82	do	Do.
Thorp	07 59.10	19 09.00	do	Do.
Trumbull	17 46.94	15 44.52	do	Do.
Van, cupola of Shippan Point House	01 40.87	31 10.84	do	Do.
Wallack	02 11.49	30 22.80	do	Do.
Warren Observatory, flagstaff (1864)	43 37.45	21 13.14	do	Do.
Watchhouse on rock, west gable	02 23.64	29 21.98	do	Do.
Webb	06 53.01	34 09.84	do	Do.
Wells	14 18.20	07 03.23	do	Do.
West Marsh	04 46.56	24 36.24	do	Do.
West Rocks	08 06.78	24 55.06	do	Do.
Wheeler	15 13.48	19 41.40	do	Do.
Whitehall church (1839)	20 02.80	08 52.37	do	Do.
Wilson Point, depot cupola	03 46.65	25 45.73	do	Do.
Woodbridge:				
Pointed spire	21 14.63	00 48.72	do	Do.
Round spire	21 17.81	00 46.17	do	Do.
Wooster Mountain	21 03.98	29 18.14	do	Bull. 122.
Great Captain Island:	40°-41°	73°-74°		
Light-house (1882-1885)	40 58 57.10	73 37 26.40	do	Rept. '88.
Light-house (1834)	58 57.18	37 26.50	do	Do.
Little Captain Island	59 24.93	36 31.01	do	Do.
Little Captain Island, 2 (1882)	59 24.97	36 31.10	do	Do.
Little Captain Island, 3 (1882)	59 19.97	36 38.95	do	Do.
Mead	59 52.00	39 03.26	do	Do.

NEW YORK.

	45°-46° ° ′ ″	74°-75° ° ′ ″		
Massena Point, triangulation station	45 00 01.67	74 46 11.79	Engr. Corps	Rept. '76.
	44°-45°	73°-74°		
Bald Peak	44 06 13.00	73 29 15.00	C. & G. S	Do.
Barber Point, light-house	09 15.84	24 17.39	do	Do.
Bigelow	26 54.12	28 09.62	do	

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	44°-45°			73°-74°				
	°	′	″	°	′	″		
Blueberry Hill	44	00	15.33	73	33	58.33	C. & G. S	
Boquet River Point		21	35.67		21	20.54	do	
Catamount		27	34.26		52	21.76	do	
Cheever		04	54.05		27	02.84	do	
Clinton Mills chimney		57	33.74		52	58.41	G. S	
Cherubusco		57	15.63		55	15.03	do	Bull. 122.
Crab Isle		39	54.51		25	02.09	C. & G. S	
Crown Point light-house		01	47.69		25	19.24	do	
Cumberland Point		41	34.43		23	28.99	do	
Dannemora		44	30.04		42	57.60	do	Do.
Dunn		49	40.85		24	10.67	do	
Giant of the Valley		09	40.39		43	14.71	do	
Hagar		42	52.42		23	22.12	do	
Haseltine		49	38.34		55	56.95	G. S	Do.
Hendrick		00	49.62		27	29.20	C. & G. S	
Hurricane		14	07.23		42	38.09	do	
Ligonier Point		24	53.04		21	55.17	do	
Lyon, 2		42	16.74		51	48.74	do	Do.
Macomb		02	48.59		46	58.66	do	
McIntyre, summit		08	37.00		59	14.00	do	
Moore		57	53.71		51	36.52	G. S	Do.
Mount Dix		04	54.51		47	12.22	C. & G. S	
Mount Marcy		06	46.04		55	26.99	do	
Poke-a-moonshine		24	06.31		30	48.83	do	
Rams Head		46	45.26		22	50.78	do	
Rand		45	28.87		36	43.99	do	
Selden		19	30.98		21	08.48	do	
Split Rock Point		15	54.96		19	44.31	do	
Trembleau Point		31	04.44		23	09.82	do	
West Hill		51	18.11		58	31.08	G. S	Do.
Whiteface		21	56.99		54	12.77	C. & G. S	
	44°-45°			75°-76°				
Alexandria	44	19	38.90	75	55	23.40	L. S	Final Rept.
Thousand Island House		20	15.20		55	16.40	do	Do.
Boundary post No. 2, Franklin County		59	58.20		39	32.20	do	Do.
Brook Point		36	54.40		36	38.00	do	Do.
Buckminster		01	32.44		59	25.80	G. S	Bull. 122.
Chapman		33	32.60		41	46.90	L. S	Final Rept.
Chimney Point		43	55.70		26	56.40	do	Do.
Crossover Island light-house		29	48.60		46	44.10	do	Do.
Dingham		21	19.00		53	04.50	do	Do.
Hall Dock		32	46.70		42	45.90	do	Do.
Lyons		25	01.50		49	00.70	do	Do.
Miller		14	21.87		45	22.13	G. S	Bull. 122.
Morristown Point		35	55.50		38	33.50	L. S	Final Rept.
Oak Point		30	56.90		45	13.10	do	Do.
Ogdensburg:								
East base		42	29.60		27	56.30	do	Do.
West base		42	19.00		28	48.50	do	Do.
Light-house, or A		41	52.30		30	14.50	do	Do.
Light-house, peak of		41	52.30		30	14.00	do	Do.
Peach Island		29	27.80		46	07.90	do	Do.
Sharp		49	07.00		17	40.80	do	Do.
Sister Island, light-house		24	50.80		50	41.90	do	Do.
Sparrowhawk		48	02.80		20	43.30	do	Do.
Sunken Rock, light-house		20	44.60		54	57.40	do	Do.
Taylor		33	05.20		42	23.70	do	Do.
Wagner		46	25.00		21	43.20	do	Do.
	44°-45°			76°-77°				
Cape Vincent	44	07	31.40	76	20	32.10	do	Do.
East base		07	41.60		17	34.70	do	Do.
West base		07	54.00		18	55.30	do	Do.
Carlton		10	58.97		17	38.75	do	Do.
Clayton:								
Roman Catholic church		14	18.80		05	12.20	do	Do.
South base, Jefferson County		14	04.10		04	34.10	do	Do.
Daly		10	03.60		18	35.10	do	Do.
Dorr farm		14	37.90		03	21.70	do	Do.
Ellis		08	34.20		17	44.00	do	Do.
Grenadier		02	11.71		22	32.40	do	Do.
Grindstone		16	04.00		08	57.80	do	Do.
Hogsback		12	02.20		09	08.10	do	Do.
Pamelia		05	24.76		52	34.78	G. S	Bull. 122.
Rock Island light-house		16	49.00		01	02.00	L. S	Final Rept.
Seeber		06	28.26		00	54.81	G. S	Bull. 122.
Tibbett Point, light-house		06	02.30		22	15.40	L. S	Final Rept.
Wolfe		07	31.12		23	19.98	do	Do.
	43°-44°			73°-74°				
Ambler	43	05	36.56	73	51	08.73	S. S	Rept. '87.
Austin		35	03.78		24	34.98	C. & G. S	

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			73°-74°				
	°	′	″	°	′	″		
Bailey	43	04	09.77	73	39	17.54	S. S	Rept. '87.
Ballston		00	48.00		51	03.00	do	Rept. '83.
Barber		34	46.32		26	02.68	C. & G. S	
Birch		20	18.94		20	11.01	G. S	Bull. 122.
Black Mountain		36	24.30		31	53.90	C. & G. S	
Breed Hill		55	19.37		25	43.27	do	
Brimstone		44	45.28		25	00.49	do	
Crain		32	41.83		57	46.36	do	
Crown Point, south base		58	51.07		25	29.44	do	
Felton Hill		01	05.64		28	10.40	G. S	Do.
Greenwich		07	35.12		31	30.61	C. & G. S	Do.
Jackson		04	41.28		23	59.08	G. S	Do.
Londonville, home lawn flag pole		43	42.91		45	35.78	S. S	Rept. '87.
Mount Tom		41	47.26		24	41.28	C. & G. S	
Prospect		25	17.95		46	04.57	do	Rept. '85.
Rascal		15	39.49		24	15.68	G. S	Bull. 122.
Saratoga		04	07.40		47	22.92	S. S	Rept. '87.
Saratoga Springs:								
Methodist Episcopal church spire		04	49.53		47	16.08	do	Do.
Presbyterian church spire		05	02.55		47	03.99	do	Do.
Catholic church spire		04	35.62		47	14.46	do	Do.
Skeenes		33	26.03		23	48.28	C. & G. S	
Snody		36	50.25		26	26.75	do	
	43°-44°			74°-75°				
Bart Hill	43	07	50.07	74	53	24.38	S. S	
Barto		07	50.07		53	24.37	do	Rept. '87.
Broadalbin:								
Baptist church cupola		03	28.94		11.	55.19	do	Do.
Methodist Episcopal church, tower.		03	27.11		11	59.81	do	Do.
Clip Hill		03	04.06		25	29.90	do	Do.
County line, stone No. 88, between Fulton and Montgomery counties.		01	09.00		39	42.00	do	Rept. '83.
Fairfield:								
Academy		08	18.12		54	47.24	do	Rept. '87.
Methodist Episcopal church		08	13.52		54	51.99	do	Do.
Presbyterian church or town hall		08	18.74		54	59.60	do	Do.
Protestant Episcopal church		08	09.20		54	40.43	do	Do.
Galway		04	05.30		02	35.49	do	Do.
Gloversville:								
Baptist church spire		02	56.16		20	49.46	do	Do.
Collins Bros.' building, flag pole		03	04.90		20	44.19	do	Do.
Congregational church, white spire.		03	03.19		20	39.82	do	Do.
First Methodist Episcopal church spire.		03	06.88		20	48.14	do	Do.
First Presbyterian church spire		03	02 34		20	48.38	do	Do.
Gore		40	15.10		02	58.49	C. & G. S	
Hamilton		24	41.82		22	00.15	do	
Herkimer		01	37.10		56	55.24	S. S	Do.
Court-house		01	44.56		59	21.96	do	Do.
Dutch Reformed church		01	44.55		59	24.56	do	Do.
Methodist Episcopal church		01	32.49		59	20.53	do	Do.
Schoolhouse		01	41.17		59	13.32	do	Do.
Johnstown:								
Court-house dome		00	24.01		22	30.02	do	Do.
Fire department house pinnacle		00	18.77		22	29.15	do	Do.
First Baptist church spire		00	22.23		22	32.03	do	Do.
Martin Kennedy's house pinnacle		00	10.32		22	28.60	do	Do.
Presbyterian church spire		00	16.50		22	23.65	do	Do.
St. Patrick's Roman Catholic church spire.		00	15.50		22	09.48	do	Do.
St. Paul's Lutheran church spire		00	28.56		22	17.33	do	Do.
Sir W. Johnson hotel flag pole		00	24.97		22	29.41	do	Do.
United Presbyterian church spire		00	26.71		22	24.17	do	Do.
Kingsboro		05	05.53		21	28.15	do	Do.
Presbyterian church tower		04	01.70		20	13.46	do	Do.
Schoolhouse cupola		03	57.22		20	12.78	do	Do.
Little Falls		02	59.51		51	38.18	do	Do.
Baptist church		02	35.75		51	26.27	do	Do.
Methodist Episcopal church		02	34.66		51	28.87	do	Do.
Presbyterian church		02	43.17		51	32.62	do	Do.
Roman Catholic church (new), Church of the Assumption.		02	37.73		51	12.15	do	Do.
Roman Catholic church (old)		02	41.45		51	08.19	do	Do.
Mayfield:								
Methodist church tower (white)		06	19.48		15	50.78	do	Do.
Presbyterian church, white, four-pinnacled tower.		06	19.80		15	48.70	do	Do.
Middle Sprite, Free Methodist church		07	15.82		38	20.78	do	Do.
North Galway, Christian church		03	57.19		03	15.13	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			74°-75°				
	°	′	″	°	′	″		
Oppenheim, Methodist Episcopal church.	43	04	23.17	74	41	36.38	S. S	Rept. '87
Perth Center, United Presbyterian church tower.		01	08.04		11	26.69	do	Do.
Royal Hill		05	08.67		31	07.95	do	Do.
St. Johnsville		00	24.92		40	12.25	do	Do.
Grace Protestant Episcopal church cross.		00	01.57		40	46.08	do	Do.
Schoolhouse cupola		00	03.23		40	35.36	do	Do.
Snowy Mountain		41	55.53		23	13.45	C. & G. S	
Speculator		27	36.03		20	24.94	do	
Twin:								
Methodist Episcopal church		02	21.23		42	52.95	S. S	Do.
Union church		02	22.56		42	53.42	do	Do.
Van der Whacken		53	53.74		05	46.96	C. & G. S	
Vedder		01	07.65		39	02.59	S. S	Do.
West Galway:								
Methodist Episcopal church		00	23.24		06	08.42	do	Do.
Presbyterian church		00	20.20		06	07.96	do	Do.
North Presbyterian church tower		00	22.00		06	09.00	do	Do.
Scotch Presbyterian church		00	14.09		06	09.45	do	Do.
West Perth		00	30.60		16	18.44	do	Do.
	43°-44°			75°-76°				
Allis	43	05	18.17	75	48	06.64	do	Do.
Amboy		23	14.20		55	07.54	do	Do.
Boynton		53	52.46		55	41.02	C. & G. S	Bull. 122.
Bridgeport, Methodist Episcopal church.		09	23.09		58	12.44	S. S	Rept. '87.
Bulger		03	55.89		39	59.75	do	Do.
Canastota		04	20.64		44	20.44	do	Do.
Baptist church		04	28.62		45	08.22	do	Do.
Free church		04	41.71		45	11.20	do	Do.
Methodist Episcopal church		04	51.81		45	19.90	do	Do.
Carl		51	37.67		46	56.10	C. & G. S	Bull. 122.
Chittenango Station, Free Methodist church.		05	15.34		52	22.93	S. S	Rept. '87.
Churchville:								
German Lutheran church (east)		11	30.42		34	16.77	do	Do.
German Lutheran church (west)		11	27.19		34	21.61	do	Do.
Seven-Day Baptist church		11	21.95		34	32.10	do	Do.
Cleveland, Protestant Episcopal church.		14	02.25		52	54.64	do	Do.
Clinton		03	17.00		01	37.44	do	Do.
Cranson		01	04.01		46	02.07	do	Do.
Deerfield Corners:								
Baptist church		06	51.15		12	08.17	do	Do.
St. Peter's church, Roman Catholic		06	58.93		12	37.54	do	Do.
Devereux		04	46.71		14	54.11	do	Do.
Durhamville:								
Baptist church		07	05.65		40	10.10	do	Do.
German Catholic church		07	09.58		40	07.96	do	Do.
Eagle		01	25.86		55	10.83	do	Do.
Eaton		01	43.99		33	19.38	do	Do.
Fish Creek, Union church		13	12.59		41	56.49	do	Do.
Florence C. S		23	14.49		39	36.30	do	Do.
Floyd Corners		13	09.86		20	06.10	do	Do.
Greene		51	22.53		48	53.76	C. & G. S	Bull. 122.
Hamilton College, chapel dome		03	07.13		24	21.29	S. S	Rept. '87.
Higginsville, Presbyterian church		10	34.71		38	40.62	do	Do.
Ilion		00	36.00		01	52.39	do	Do.
Presbyterian church		00	48.03		02	20.34	do	Do.
St. Mary's church, Roman Catholic		00	41.58		01	45.18	do	Do.
Johnson		57	16.05		50	33.36	C. & G. S	Bull. 122.
Jackson		05	54.86		01	41.39	S. S	Do.
Kirkville		04	19.54		56	16.23	do	Rept. '87.
Methodist Episcopal church		04	31.00		57	04.85	do	Do.
Lowrey		41	47.37		59	55.94	C. & G. S	Bull. 122.
Manlius Station, Methodist Episcopal church.		04	41.94		59	55.74	S. S	Rept. '87.
Merry		02	51.54		10	24.00	do	Do.
Mohawk:								
Dutch Reformed church		00	36.42		00	19.83	do	Do.
Methodist Episcopal church		00	43.31		00	10.12	do	Do.
Universalist church		00	39.79		00	29.48	do	Do.
New York Mills Methodist Episcopal church.		06	13.01		17	36.79	do	Do.
North Gage, Union church		13	23.17		07	12.32	do	Do.
North Manlius P. O.:								
Baptist church		05	57.91		58	22.11	do	Do.
Methodist Episcopal church		06	01.22		58	20.75	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			75°-76°				
Oneida:	°	′	″	°	′	″		
Baptist church	43	05	37.29	75	39	06.25	S. S	Rept. '87.
Opera-house dome		05	44.29		39	10.45	do	Do.
Presbyterian church		05	38.45		39	06.91	do	Do.
Castle Presbyterian church		04	46.07		38	06.51	do	Do.
Perryville, Protestant Episcopal church.		00	24.81		47	57.27	do	Do.
Prospect		02	15.39		26	40.36	do	Do.
Quality Hill, Presbyterian church		04	03.39		46	33.31	do	Do.
Ridgeville, Presbyterian church		07	57.27		47	28.96	do	Do.
Rome		14	03.00		27	58.13	do	Do.
Baptist church		12	58.74		27	33.25	do	Do.
First Methodist Episcopal church		12	59.08		27	30.77	do	Do.
German Catholic church		12	48.27		27	33.95	do	Do.
Presbyterian church		12	49.47		27	23.37	do	Do.
St. Joseph's church (Roman Catholic).		12	28.22		27	44.19	do	Do.
Welsh Presbyterian church		12	52.61		27	33.22	do	Do.
Russia Union church		15	28.76		04	47.63	do	Do.
Schuyler		09	43.94		06	59.12	do	Do.
Starr		20	42.20		14	59.31	do	Rept. '87.
Thomas		34	36.42		58	54.09	C. & G. S	Bull. 122.
Tyler, Wesleyan Methodist church		05	40.74		54	50.04	S. S	Rept. '87.
Utica:								
City hall, flag pole		06	03.47		13	58.48	do	Do.
First Methodist Episcopal church		06	01.09		14	08.94	do	Do.
First Dutch Reformed church		05	55.60		14	14.59	do	Do.
First Presbyterian church		06	07.33		13	58.95	do	Do.
Grace Protestant Episcopal church.		06	04.41		13	53.36	do	Do.
St. Patrick's church (Roman Catholic).		06	15.36		14	28.33	do	Do.
Trinity Protestant Episcopal church.		06	09.26		13	25.04	do	Do.
Westminster church		06	02.18		14	03.28	do	Do.
Vernon:								
Baptist church		04	47.02		32	31.39	do	Do.
Methodist Episcopal church		04	43.39		32	29.00	do	Do.
Presbyterian church		04	39.73		32	35.09	do	Do.
Unitarian church		04	45.41		32	28.80	do	Do.
Vernon Center:								
Methodist Episcopal church		03	11.21		30	08.94	do	Do.
Presbyterian church		03	11.20		30	05.91	do	Do.
Verona:								
Methodist Episcopal church		08	13.82		34	18.43	do	Do.
Presbyterian church		08	18.71		34	15.85	do	Do.
Vienna		14	49.63		40	47.47	do	Do.
Methodist Episcopal church		14	21.43		42	10.08	do	Do.
Watertown, court-house, northeast corner of cupola.		58	32.88		55	01.95	L. S	Final Rept.
Wampsville, Presbyterian church		04	29.99		42	20.98	S. S	Rept. '87
Westmoreland, Presbyterian church		06	56.61		24	21.34	do	Do.
West Schuyler, Methodist Episcopal church.		05	55.73		09	09.96	do	Do.
Whitesboro, Baptist church		07	23.86		17	34.03	do	Do.
Williams		10	15.13		13	20.90	do	Do.
	43°-44°			76°-77°				
Amboy, Presbyterian church spire	43	04	14.00	76	16	19.00	do	Rept. '83.
Big Sodus, light-house, Wayne County.		16	25.70		59	11.80	L. S	Final Rept.
Brayton barn, cupola, west wing		04	14.33		04	47.09	S. S	Rept. '87
Brewerton, west spire of Disciples church.		14	16.21		08	26.26	do	Do.
Carpenter		00	33.93		17	05.36	do	Do.
Cassett		00	02.19		11	35.09	do	Do.
Central Square, church spire		17	13.50		08	45.88	do	Do.
Chestnut Ridge		05	48.66		11	14.77	do	Do.
Clyde, L. S		03	05.07		51	49.34	do	Do.
Collamer		06	04.87		03	28.77	do	Do.
Methodist Episcopal church		06	15.13		03	53.64	do	Do.
Colwell		41	40.56		11	10.78	G. S	Bull. 122.
Constantia, Presbyterian church		14	55.00		00	11.00	S. S	Rept. '83.
Cooper		57	48.20		16	41.50	L. S	Bull. 122.
Davison		06	07.41		17	04.12	S. S	Rept. '87.
Deuel		54	23.90		12	29.30	do	
Draper		03	02.67		12	10.75	do	Do.
Dyke		31	39.54		14	24.76	G. S	Bull. 122.
Fairmount		02	36.75		15	22.68	S. S	Rept. '87.
Fayetteville:								
Presbyterian church		01	45.50		00	27.09	do	Do.
Protestant Episcopal church		01	45.76		00	25.23	do	Do.
Roman Catholic church		01	47.21		00	16.20	do	Do.

NEW YORK—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	43°-44°	76°-77°		
	° ′ ″	° ′ ″		
	43 58 05.60	76 12 04.20	L. S	Rept. '87.
., Falley Academy	19 17.00	24 43.00	S. S	Rept. '83.
	55 07.60	24 36.10	L. S	Final Rept.
;ht-house	53 18.60	26 41.90	do	Do.
rt	11 56.77	32 31.90	do	Do.
s, Methodist Episcopal church	03 07.17	11 23.97	S. S	Rept. '87.
tsville	18 42.32	17 49.66	do	Do.
n	52 48.90	15 32.80	L. S	Bull. 122.
e	31 30.80	22 24.20	do	Do.
on	31 30.30	15 19.20	do	
	53 04.77	14 09.99	G. S	Do.
ey	07 12.90	18 00.25	S. S	Rept. '87.
ool, Methodist Episcopal ch spire.	06 13.72	12 24.86	do	Do.
s	21 18.46	17 10.37	C. & G. S	Bull. 122.
ville	42 54.41	03 14.61	L. S	Do.
Davis	09 47.34	18 44.36	S. S	Rept. '87.
base, between Jefferson and ego counties.	40 43.61	12 02.03	L. S	
up	00 03.70	21 25.39	S. S	Do.
us	02 04.24	07 55.56	do	Do.
aga Hill, Presbyterian church	00 12.53	11 00.98	do	Do.
o	26 37.28	30 50.41	L. S	Final Rept.
Do	26 39.57	30 53.55	do	Do.
urt-house	27 26.00	30 22.80	do	Do.
ght-house	27 53.90	30 50.90	do	Do.
ts Harbor, or Horse Island, -house.	56 34.70	08 43.00	do	Do.
Creek	39 06.93	06 08.40	do	Bull. 122.
ood	02 13.45	17 17.22	S. S	Rept. '87.
Star, St. Mary's church	05 15.29	00 08.33	do	Do.
Hill	06 51.54	21 23.62	do	Do.
base	38 05.19	11 51.52	L. S	
Point	50 47.56	17 28.19	do	Final Rept.
ght-house	50 21.60	17 56.80	do	Do.
use:				
rst Presbyterian church spire	02 54.73	09 08.26	S. S	Rept. '87.
John's Roman Catholic church spire.	04 06.74	09 28.81	do	Do.
Lucy's Roman Catholic church spire.	02 36.27	09 45.39	do	Do.
r	01 14.82	33 29.82	do	Do.
y L. S	13 06.82	36 22.13	do	Do.
	43°-44°	77°-78°		
port	43 11 28.81	77 56 03.68	L. S	Final Rept.
ptist church	12 49.70	56 23.50	do	Do.
rner of lots 5, 8, 11, 14	11 54.00	56 39.30	do	Do.
ee, light-house	15 09.80	36 40.20	do	Do.
ra L. S	04 03.76	09 37.78	S. S	Rept. '87
cle Hill	08 06.47	35 10.67	L. S	
ster:				
ty Hall statue	09 22.44	36 51.00	do	Final Rept.
urt-house	09 18.10	36 50.70	do	Do.
wer of waterworks	12 45.80	37 36.70	do	Do.
	14 13.74	04 44.74	do	Do.
me of Academy	14 08.50	04 09.30	do	Do.
Hill	02 10.44	25 23.26	S. S	Rept. '87.
orth	09 22.43	20 01.25	L. S	Final Rept.
ma Center:	43°-44°	78°-79°		
ptist church spire	43 05 42.49	78 23 22.08	S. S	Rept. '87.
ethodist Episcopal church spire	05 45.49	23 19.90	do	Do.
1	14 22.65	09 19.67	L. S	Final Rept.
1 Cemetery, soldier's head on ument.	11 22.75	19 29.76	S. S	Rept. '87.
Center, Presbyterian church	11 06.80	11 41.24	do	Do.
ia	01 18.05	15 45.63	do	Do.
ind Institute, flag pole	00 21.51	11 05.99	do	Do.
us	05 48.63	17 34.41	do	Do.
gham's house, center	05 47.67	17 35.01	do	Do.
Shelby	10 03.45	19 58.83	do	Do.
lvent church spire	10 10.87	19 31.20	do	Do.
ethodist Episcopal church spire	09 23.65	19 32.30	do	Do.
rds	08 54.61	22 03.90	do	Do.
	05 32.26	08 42.99	do	Do.
ethodist Episcopal church spire	04 51.46	11 06.94	do	Do.
esbyterian church spire	04 58.19	11 11.96	do	Do.
hoolhouse cupola, district No. 2	05 28.46	09 23.91	do	Do.
k	01 22.85	28 58.22	L. S	Final Rept.
ng	09 42.98	10 33.96	S. S	Rept. '87.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	43°-44°			78°-79°				
	°	′	″	°	′	″		
Kimpton's (S.) barn, west cupola	43	00	30.33	78	11	11.85	S. S	Rept. '87.
Macomber, 302		04	30.34		18	39.60	do	Do.
Macomber's, J. S., house tower		04	38.52		18	41.29	do	Do.
Monument 300		11	00.46		11	40.14	do	Do.
Monument 363		09	50.54		19	31.47	do	Do.
Monument 367		04	57.51		11	12.17	do	Do.
Morganville (L. S.)		00	40.11		02	58.60	do	Do.
Christian church tower		00	13.44		04	35.40	do	Do.
Oakfield		04	05.72		16	25.68	do	Do.
Methodist Episcopal church tower		04	01.90		16	24.05	do	Do.
Presbyterian church tower		04	06.14		16	24.76	do	Do.
Seminary tower		03	55.90		16	09.92	do	Do.
Parker		06	56.40		09	50.49	do	Do.
Pekin		10	14.70		52	31.28	L. S	Final Rept.
Pond		03	35.94		19	38.56	S. S	Rept. '87.
Pumpkin Hill, Baptist church		05	51.89		04	01.41	do	Do.
Pusel		09	56.73		15	47.60	do	Do.
Quaker church, east gable		06	01.20		11	37.72	do	Do.
Ross		10	43.20		21	29.95	do	Do.
Ryan		10	25.76		24	37.39	do	Do.
South Alabama, Baptist church spire		04	23.46		20	07.61	do	Do.
Tall Tree		10	12.80		23	35.66	do	Do.
Thirty-mile Point, light		22	29.60		29	11.80	L. S	Final Rept.
Tonawanda		00	03.84		53	21.91	do	Bull. 122.
Vulgary		06	54.09		12	12.11	S. S	Rept. '87.
Watson's (David) barn, west gable		06	44.77		07	57.59	do	Do.
West Barre, Methodist Episcopal church cupola.		09	07.13		15	11.47	do	Do.
West Shelby, Methodist Episcopal church spire.		09	39.26		26	12.95	do	Do.
Yates, spire of church		20	15.80		23	17.50	L. S	Final Re
	43°-44°			79°-80°				
Fort Niagara, light-house	43	15	42.30	79	03	40.00	do	Do.
Niagara Falls, northeast tower of railroad suspension bridge.		06	34.10		03	26.30	do	Do.
	42°-43°			73°-74°				
Abutment	42	39	15.26	73	44	39.80	S. S	Rept. '87.
Academy Hill		14	37.87		46	36.24	do	Do.
Adams		59	52.82		21	04.00	C. & G. S	Bull. 122.
Adamsville, Methodist Episcopal church.		37	21.66		50	11.36	S. S	Rept. '87.
Albany:								
Academy of the Sacred Heart		37	40.18		40	21.06	do	Do.
Congregational Church spire		38	57.98		45	26.92	do	Do.
Cathedral spire		38	51.31		45	35.55	do	Do.
Dudley Observatory, center of equatorial dome.		39	51.81		45	01.47	do	Do.
First Lutheran church		39	06.88		45	13.25	do	Do.
Fourth Presbyterian church spire		39	20.23		44	57.86	do	Do:
German Roman Catholic church, Our Lady of the Angel.		39	43.30		46	10.07	do	Do.
Sacred Heart Roman Catholic church, North Albany.		40	20.03		44	23.22	do	Do.
St. Patrick's Roman Catholic church spire.		39	50.25		46	17.96	do	Do.
St. Paul's German Evangelical Lutheran church spire.		39	32.36		46	08.89	do	Do.
St. Peter's Protestant Episcopal church spire.		39	02.88		45	15.91	do	Do.
Second Presbyterian church spire.		39	04.44		45	12.24	do	Do.
State Hall, flag pole		39	07.00		45	17.00	do	Rept. '83.
State Street Presbyterian church spire.		39	13.70		45	41.16	do	Rept. '87.
Tabernacle Baptist church spire		39	19.05		45	06.73	do	Do,
Trinity Methodist Episcopal church.		39	18.05		45	56.79	do	Do.
Waterworks chimney		40	22.00		46	42.00	do	Rept. '83.
Waterworks gatehouse pole		40	23.00		46	49.00	do	Do.
Alvord		19	10.52		46	29.39	do	Rept. '87.
Arsenal		43	11.01		42	06.58	do	Do.
Athens:								
Knickerbocker Ice Company's chimney.		15	55.10		48	18.18	do	Do.
Protestant Episcopal church		15	53.99		48	27.82	do	Do.
Reformed church		15	48.08		48	42.28	do	Do.
Schoolhouse cupola, District No. 1		16	15.51		48	16.78	do	Do.
Barren Island		27	51.78		47	09.03	do	Do.
Flag pole		28	05.45		47	11.84	do	Do.
Bailey		24	04.19		46	44.47	do	Do.
Baker		31	48.13		46	00.86	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
ounds	42	38	38.06	73	44	45.52	S. S	Rept. '87.
		39	35.30		43	53.63	do	Do.
		59	58.51		31	40.60	C. & G. S	Bull. 122
		27	44.40		46	04.52	S. S	Rept. '87.
ere Hotel, flag pole		35	54.80		44	18.34	do	Do.
		22	21.63		47	06.24	do	Do.
hem		34	45.94		47	52.86	do	Do.
tch Reformed church, north of ecker Corner.		33	43.29		48	19.78	do	Do.
Rock		15	23.22		48	51.39	do	Do.
t		30	56.93		53	44.91	do	Do.
ill		11	05.64		48	55.51	C. & G. S	
		26	53.12		46	18.60	S. S	Do.
lus		22	08.70		47	56.94	do	Do.
use, east gable		22	11.47		47	58.41	do	Do.
r		17	16.86		46	31.75	do	Do.
		25	37.90		47	25.92	do	Do.
n cupola		25	32.73		47	17.79	do	Rept. '87.
nd		24	16.49		47	12.08	do	Do.
ns		00	29.27		57	13.95	C. & G. S	Do.
Hills		54	35.82		54	16.45	S. S	Do.
istian church		54	35.64		53	31.54	do	Do.
ptist church		54	25.59		53	47.60	do	Do.
ell		42	10.86		44	21.89	do	Do.
nd		33	17.93		45	05.28	do	Do.
		34	12.65		59	15.72	do	Do.
on		32	11.22		45	14.92	do	Do.
tch Reformed church		31	58.00		45	21.41	do	Do.
Hill		32	57.83		45	33.29	do	Do.
street		44	34.55		41	26.66	do	Do.
's (F. E.) house tower		13	01.37		49	46.74	do	Do.
r		30	59.83		45	43.01	do	Do.
ville		34	32.83		57	38.30	do	Do.
tch Reformed church spire		34	32.00		57	40.00	do	Rept. '83.
arn flag pole		18	14.98		47	40.20	do	Rept. '87.
ans:								
demy		28	23.40		47	55.24	do	Do.
netery, Briggs monument		28	01.78		47	42.39	do	Do.
e light-house		28	30.93		47	04.17	do	Do.
k flag pole		28	23.00		47	24.00	do	Rept. '83.
, Roman Catholic church		46	27.15		41	57.95	do	Rept. '87.
		24	39.88		47	28.40	do	Do.
Creek		35	10.87		45	13.76	do	Do.
g		36	54.35		46	15.03	do	Do.
yman		37	02.04		59	20.68	do	Do.
line monument		46	33.00		47	59.00	do	Rept. '83.
land, light-house		32	16.18		45	20.78	do	Rept. '87.
kie		21	10.27		47	44.97	do	Do.
. Co.'s flag pole		20	48.55		47	30.42	do	Do.
ht-house		22	47.18		47	42.78	do	Do.
thodist Episcopal church tower		20	58.52		47	53.64	do	Do.
ble's brickyard chimney		21	42.02		48	12.84	do	Do.
testant Episcopal church		21	11.10		48	13.18	do	Do.
man Catholic church, cross		20	57.97		47	45.52	do	Do.
ilroad station chimney		21	15.50		47	00.79	do	Do.
formed church		20	54.78		47	51.29	do	Do.
per Village Reformed church		21	43.17		49	18.51	do	Do.
nd		22	00.92		47	39.04	do	Do.
n		36	50.21		45	21.68	do	Do.
ie's Hook (bolt)		35	42.63		45	50.65	do	Do.
		16	25.71		46	49.53	do	Do.
ville, Methodist Episcopal ch spire.		44	34.00		58	55.00	do	Rept. '83.
Reformed church, 1 mile north cker Corner.		38	42.00		48	20.00	do	Do.
lbany, St. John's Roman Catho- urch.		38	26.12		44	20.90	do	Rept. '87.
reenbush:								
tch Reformed church		35	18.42		42	00.69	do	Do.
thodist Episcopal church		35	16.17		41	57.35	do	Do.
		40	35.51		45	13.30	do	Do.
Bush, Dutch Reformed church .		34	35.00		52	53.00	do	Rept. '83.
ook Island, light-house		27	48.75		46	55.24	do	Rept. '87.
		40	07.68		43	12.61	do	Do.
am Point		20	40.13		46	52.15	do	Do.
Mile Point		18	21.96		47	01.83	do	Do.
ght-house		18	21.91		47	01.49	do	Do.
t yard		16	36.77		47	51.94	do	Do.
gh		46	35.27		47	12.17	do	Do.
view		35	55.66		43	56.92	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	'	"	°	'	"		
Greenbush:								
Presbyterian church	42	38	10.70	73	44	56.76	S. S	Rept. '87.
Ferry		38	30.21		45	03.56	do	Do.
Greenport, Reformed church		11	56.18		48	12.89	do	Do.
Guilderland		42	02.29		58	01.51	do	Do.
Church spire		42	14.00		58	10.00	do	Rept. '83.
Lutheran church spire		42	15.24		58	09.74	do	Rept. '87.
Hallenbeck		35	56.18		40	08.38	C. & G. S	Do.
South		16	19.20		49	58.70	S. S	Do.
Hamiltonville:								
Methodist Episcopal church spire		42	16.00		54	43.00	do	Rept. '83.
Three point (no station mark)		42	29.17		55	12.76	do	Rept. '87.
Hotailing Island		26	55.95		46	55.92	do	Do.
Home Lawn flag pole		43	41.00		45	36.00	do	Rept. '83.
Hudson (bolt)		15	22.54		47	51.34	do	Rept. '87.
Baptist church		15	05.93		47	27.95	do	Do.
Light-house		15	07.29		48	33.01	do	Do.
Lutheran church		14	55.30		47	03.34	do	Do.
Presbyterian church		15	04.27		47	21.98	do	Do.
Protestant Episcopal church		15	00.24		47	22.53	do	Do.
Roman Catholic church		15	05.09		47	38.86	do	Do.
Universalist church		15	00.31		47	14.32	do	Do.
Waterworks chimney		15	19.54		47	54.66	do	Do.
Iron works		42	23.39		41	47.03	do	Do.
Judson		19	47.63		46	03.76	do	Do.
Judson, barn cupola		19	44.00		46	01.00	do	Rept. '83.
Junction		19	48.24		46	26.15	do	Rept. '87.
Kinderhook, Reformed church		23	36.71		42	04.58	do	Do.
Knickerbocker, house cupola		27	40.55		46	11.99	do	Do.
Lampman		20	28.32		47	43.68	do	Do.
Lansing		44	12.82		42	58.58	do	Do.
Lansing Pine		45	38.73		50	37.75	do	Do.
Lisha's Kill, Dutch Reformed church		45	21.91		52	35.76	do	Do.
Lower Schodack Island		27	42.16		46	33.69	do	Do.
Merino, Columbia County		14	05.06		49	03.54	do	Bull. 122.
Merwin		21	23.61		41	23.01	do	Do.
Milham (Levi), house cupola		23	49.92		43	26.08	do	Rept. '87.
Moles		37	43.18		45	02.77	do	Do.
Monument 20		45	26.61		57	49.07	do	Do.
Monument 97		46	28.07		49	24.17	do	Do.
Monument 192		40	47.28		43	23.57	do	Do.
Morrison		15	14.35		49	39.93	do	Do.
Mount Merino		14	05.06		49	03.53	do	Do.
Mount Olympus		44	40.24		41	01.67	do	Do.
Mull		29	55.00		47	04.07	do	Do.
Mull Island		28	26.46		47	04.62	do	Do.
Mull Plaat		29	18.09		47	00.39	do	Do.
Muller		34	16.31		44	59.99	do	Do.
New Baltimore:								
Baptist church		26	46.49		47	24.54	do	Do.
Dike light-house		27	08.99		46	34.80	do	Do.
Dutch Reformed church		26	44.71		47	20.78	do	Do.
Light-house		27	04.42		47	02.69	do	Do.
Methodist Episcopal church		26	53.94		47	17.69	do	Do.
Riverside House, summer-house flag pole.		26	44.09		47	13.22	do	Do.
Shipyard, chimney of		26	39.43		47	12.88	do	Do.
New Salem, Dutch Reformed church		37	25.10		57	58.31	do	Do.
New Scotland, Presbyterian church tower.		37	53.91		54	24.41	do	Do.
Nine-mile Tree, light-house		31	05.22		45	53.64	do	Do.
Niskayuna		46	00.32		49	57.62	do	Do.
Nutter Hook		21	25.86		47	20.25	do	Do.
Olcott's house, cupola		37	53.02		43	13.11	do	Do.
Orchard		27	37.68		47	34.84	do	Do.
Paarda Hook		33	18.15		45	25.57	do	Do.
Papscanee Island		35	54.87		45	29.46	do	Do.
Parke		35	59.85		46	04.96	do	Do.
Parsons		27	09.59		47	31.39	do	Do.
Patten		15	27.72		47	10.01	do	Do.
Patterson		36	13.07		45	49.75	do	Do.
South chimney of house		36	09.08		46	26.86	do	Do.
Powell		23	20.60		51	50.69	C. & G. S	Bull. 122.
Railroad farm		17	37.63		47	50.96	S. S	Rept. '87.
Railway		41	11.94		42	38.32	do	Do.
Race course		41	17.34		42	54.99	do	Do.
Rafinesque		47	21.15		36	58.82	C. & G. S	Rept. '85.
Rexford Flats		51	23.23		53	50.53	S. S	Do.
Riley		41	42.83		42	08.15	do	Do.
Roha Hook		29	06.10		47	23.72	do	Do.
Light-house		28	50.37		47	19.54	do	Rept. '87.
Rotterdam, Methodist Episcopal church.		46	47.49		57	29.91	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
Round Top	42	05	14.39	73	52	23.68	C. & G. S.	
Rural Cemetery, Williams monument		41	54.00		44	15.20	S. S	Rept. '87.
Rysedorph		37	38.71		43	10.93	do	Do.
Sage		40	02.18		44	04.83	do	Do.
Schermerhorn Island		31	20.19		45	59.55	do	Do.
Schenectady:								
Armory, flag pole		48	36.81		56	18.97	do	Do.
Baptist church spire		48	56.80		56	23.58	do	Do.
First Dutch Reformed church spire.		49	00.98		56	51.27	do	Do.
First Presbyterian church spire		49	02.78		56	42.69	do	Do.
German Methodist Episcopal church spire.		48	56.74		56	12.16	do	Do.
St. George's Protestant Episcopal church spire.		49	05.68		56	42.84	do	Do.
St. John's Roman Catholic church spire.		48	51.34		56	30.20	do	Do.
St. John's German Roman Catholic church spire.		48	40.28		56	25.57	do	Do.
Second Reformed church spire		48	53.28		56	23.44	do	Do.
State Street Methodist Episcopal church spire.		48	42.34		56	21.95	do	Do.
Union College dome		49	02.35		55	49.33	do	Do.
Union School		49	01.08		56	32.88	do	Do.
Schodack, channel light-house		29	51.94		46	41.66	do	Do.
Schodack Island		30	27.07		46	21.22	do	Do.
Schodack Landing:								
Dutch Reformed church		28	49.38		46	13.01	do	Do.
Knickerbocker ice house, flag pole		28	24.79		46	25.96	do	Do.
Schoolhouse cupola, near Mull		30	24.00		47	17.00	do	Rept. '83.
Schuyler		42	20.88		42	30.58	do	Rept. '87.
Scotia:								
Baptist church spire		49	34.41		57	48.64	do	Do.
Dutch Reformed church tower		49	40.15		57	37.06	do	Do.
Seward		40	30.60		39	46.50	do	Do.
Shad Island		30	53.72		46	22.65	do	Do.
Shart		17	34.43		46	05.05	do	Do.
Sickels		22	57.58		46	58.63	do	Do.
Slingerland		37	35.41		51	58.26	do	Do.
Methodist Episcopal church spire		37	50.52		51	38.49	do	Do.
Stevens		19	20.65		47	13.84	do	Do.
Stockport		18	01.69		46	11.77	do	Do.
Railway station, chimney		18	37.36		46	20.63	do	Do.
Stone House		25	25.27		47	11.51	do	Do.
Stuyvesant		23	21.83		46	00.01	do	Do.
Light-house		24	41.02		46	43.04	do	Do.
Lutheran church		23	24.43		46	23.82	do	Do.
Reformed church tower		23	16.70		46	55.86	do	Do.
Teller		36	26.33		44	05.71	do	Do.
Ten Eyck		28	48.11		45	49.84	do	Do.
Terry		23	01.75		47	58.36	do	Do.
Thistle		24	55.23		46	29.83	do	Do.
Tracy		25	25.26		44	31.71	do	Do.
Traver		30	14.70		45	39.55	C. & G. S	
Troy:								
French Roman Catholic church		43	21.57		41	37.25	S. S	Do.
St. Mary's Roman Catholic church.		43	28.86		41	30.99	do	Do.
Ninth Presbyterian church		44	31.07		41	04.93	do	Do.
Park Presbyterian church		43	25.19		41	37.86	do	Do.
St. John's convent		42	56.64		41	29.80	do	Do.
St. John's Protestant Episcopal church.		43	32.21		41	39.63	do	Do.
St. Joseph's Provincial Seminary, northwest spire.		43	45.89		40	59.03	do	Do.
St. Michael's Roman Catholic church.		42	04.67		41	48.72	do	Do.
St. Paul's Protestant Episcopal church.		43	45.61		41	27.17	do	Do.
St. Peter's church, Roman Catholic.		44	16.84		41	07.76	do	Do.
State Street Methodist Episcopal church.		43	58.55		41	16.82	do	Do.
Round chimney near east end of State dam.		44	47.11		41	05.53	do	Do
Troy cemetery, Wool's monument.		45	40.34		40	12.75	do	Do.
University, northwest spire		42	43.00		41	00.00	do	Rept. '83.
Unionville, Dutch Reformed church spire.		36	02.00		53	28.00	do	Do.
Upper Red Hook		01	24.50		50	40.45	C. & G. S.	

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			73°-74°				
	°	′	″	°	′	″		
Van Alstyne	42	25	53.77	73	46	18.65	S. S	Rept. '87.
Van Buren		23	17.97		43	38.34	do	Do.
Van Dalfson		23	01.48		47	31.77	do	Do.
Van Denburg		33	10.08		44	09.71	do	Do.
Vanderpoel		26	28.43		47	16.62	do	Do.
Vanderzer		32	33.12		46	24.18	do	Do.
Van Rensselaer (C. S.)		39	02.10		43	38.10	do	Do.
Van Slyke		23	47.92		47	54.72	do	Do.
Van Wie		34	54.98		45	22.71	do	Do.
Van Wie, stone light		35	05.70		45	29.59	do	Do.
Vineyard		20	13.56		47	21.03	do	Do.
Visehee Ferry, church spire		47	47.17		49	35.63	do	Do.
Vrooman		30	42.92		46	53.36	do	Do.
West Albany		40	38.00		46	30.00	do	Rept. '83.
West Ghent, Dutch Reformed church		17	33.81		43	03.60	do	Rept. '87.
West Troy:								
Baptist church		43	41.89		42	11.79	do	Do.
Dutch Reformed church		42	48.83		42	33.95	do	Do.
First Dutch Reformed church		43	33.88		42	05.80	do	Do.
St. Bridget Roman Catholic church.		42	53.48		42	27.60	do	Do.
Westertoe Island		37	20.13		45	40.82	do	Do.
Whannel		27	02.56		46	00.26	do	Do.
Whitehead's barn, west gable		21	31.47		46	45.66	do	Do.
Winnie's Dock		33	53.94		45	16.96	do	Do.
Winnie's Point		33	17.00		45	26.00	do	Rept. '83.
Wiswall		14	49.09		48	53.57	do	Rept. '87.
Wood		21	54.72		46	53.82	do	Do.
Yellow Pine		29	28.72		40	27.90	C. & G. S	
	42°-43°			74°-75°				
Adebahr	42	52	26.92	74	10	42.01	S. S	Do.
Amsterdam:								
Academy		56	34.95		11	28.74	do	Do.
Roman Catholic church spire		56	06.68		11	17.15	do	Do.
Argusville		47	50.00		31	12.55	do	Do.
Auriesville, Dutch Reformed church		55	43.86		18	50.52	do	Do.
Babcock		37	46.70		15	59.91	do	Do.
Baracsourie		43	30.71		29	26.18	do	Do.
Barrow's (W. C.) house		47	53.15		20	47.80	do	Do.
Bell's (W. H.) house		47	30.60		19	48.22	do	Do.
Black		58	44.08		10	04.23	do	Do.
Bouck		37	42.41		18	51.26	do	Do.
Bramans Corner, Baptist church spire.		47	49.00		15	05.00	do	Do.
Brandmill		54	32.14		02	38.36	do	Do.
Bronk		56	53.52		05	35.02	do	Do.
Canajoharie:								
Dutch Reformed church		54	18.25		34	12.92	do	
German Lutheran church		54	14.99		34	10.55	do	Do.
Nellis House		54	22.22		34	20.74	do	Do.
Protestant Episcopal church		54	14.70		34	19.38	do	Do.
Chapman		47	19.44		13	18.47	do	Do.
Charleston Four Corners, church tower.		48	50.00		24	46.00	do	Rept. '83.
Cobleskill:								
Hotel Augusta		40	41.44		29	06.05	do	Rept. '87.
Lutheran church		40	43.06		28	57.07	do	Do.
Carlisle, Presbyterian church		45	23.66		26	44.79	do	Do.
Catskill		11	23.85		02	14.59	C. & G. S	Do.
Mountain House, southeast corner.		11	41.00		02	06.60	S. S	Do.
Conover		46	58.61		17	26.66	do	Do.
Currytown, Dutch Reformed church tower.		51	35.17		28	09.65	do	Do.
Dockstader		45	25.37		40	07.69	do	Do.
Dougal		53	08.97		07	21.63	do	Do.
Duanesburg, church tower		46	10.00		09	25.00	do	Rept. '83.
Dunn Hill		59	26.38		22	16.02	do	Do.
Dunnsville:								
Flag pole		44	23.00		01	03.00	do	Do.
Dutch Reformed church west of		45	07.00		02	44.00	do	Do.
East Hill, primary		46	53.00		42	16.00	do	Do.
East Township, Baptist church spire		42	13.00		05	42.00	do	Do.
Esperance:								
Methodist Episcopal church		45	39.44		15	29.08	do	Rept. '87.
Presbyterian church		45	44.40		15	39.79	do	Do.
Failing		55	29.50		33	21.54	do	Do.
Finkel		47	00.72		29	02.00	do	Do.
Fonda		57	23.23		22	19.15	do	Do.
Court-house dome		57	13.05		22	34.29	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			74°-75°				
ain:	°	'	"	°	'	"		
ton Liberal Institute	42	55	54.23	74	37	47.90	S. S	Rept. '87.
ch church spire		55	53.73		37	41.39	do	Do.
hodist Episcopal church spire		55	56.57		37	31.81	do	Do.
Bush, Methodist Episcopal h spire.		54	36.51		40	04.57	do	Do.
ville, J. H. Starin's house cu-		56	34.95		21	54.72	do	Do.
		53	22.60		19	25.97	do	Do.
ch Reformed church spire		53	41.88		20	31.47	do	Do.
n Evangelical church tower		57	29.00		31	07.00	do	Rept. '83.
an Mills, church		58	27.00		09	01.33	do	Rept. '87.
berg (C. S.)		37	39.07		00	38.47	do	Do.
eak		10	05.00		05	42.00	do	Rept. '83.
		37	36.10		30	49.79	do	Rept. '87.
		10	39.50		13	49.31	G. S	Bull. 122.
		37	32.88		21	54.68	S. S	Rept. '87.
rsville		42	12.02		02	00.58	do	Do.
heran church		42	11.87		02	01.64	do	Do.
		59	08.45		05	47.39	do	Do.
lle:								
hodist Episcopal church spire		40	23.00		06	18.00	do	Rept. '83.
heran church spire, 2 miles st of town.		40	38.00		04	45.00	do	Do.
'alls, Universalist church		02	34.00		51	27.00	do	Do.
		41	04.98		19	05.23	do	Rept. '87.
s Corners, church		56	50.56		08	42.36	do	Do.
own		49	48.60		33	14.08	do	Do.
ch Reformed church tower		50	20.75		33	33.26	do	Do.
burg, Dutch Reformed church ire.		36	18.51		20	16.23	do	Do.
hodist Episcopal church spire		35	48.97		19	58.73	do	Do.
ent 46 (C. B.)		44	24.81		05	54.74	do	Do.
ent 52 (C. B.)		43	00.11		14	29.35	do	Do.
ent 53 (C. B.)		49	48.96		13	14.96	do	Do.
ent 74 (C. B.)		45	04.97		00	23.71	do	Do.
		58	46.00		37	15.55	do	Do.
lge		47	28.11		19	19.98	do	Do.
sson C. Barlow's house		47	52.00		20	49.00	do	Rept. '83.
atine, church spire		58	08.63		37	42.88	do	Rept. '87.
(C. S.)		46	54.73		42	14.60	do	Do.
ler		57	25.44		48	26.10	do	Do.
k Mountain		05	05.00		05	33.00	do	Rept. '83.
Hollow, Methodist Episcopal h.		57	39.35		54	14.06	do	Rept. '87.
e, German Evangelical church		57	29.95		31	05.90	do	Do.
		22	39.18		14	43.27	G. S	Bull. 122.
own		50	46.53		05	47.28	S. S	
sbyterian church spire		48	25.00		04	47.00	do	Rept. '83.
n		53	47.42		35	45.40	do	Rept. '87.
ld Springs, observatory		50	33.15		56	58.57	do	Do.
ndville, hotel flag pole		38	02.00		33	53.00	do	Rept. '83.
l		58	21.29		31	28.21	do	Rept. '87.
Corners, church tower		58	43.44		38	44.57	do	Do.
n		54	42.12		05	11.75	do	Do.
l		27	15.27		03	04.84	G. S	Bull. 122.
n's (Ezra I.) house, cupola		57	14.73		33	15.26	S. S	Rept. '87.
nsville:								
hodist Episcopal church spire		59	57.39		40	44.48	do	Do.
on church tower		59	57.01		40	50.16	do	Do.
rie:								
netery, Williams monument		39	47.22		18	34.85	do	Do.
heran church spire		39	53.01		18	40.21	do	Do.
Fort flag pole		40	38.64		18	08.02	do	Do.
er		58	54.72		26	35.71	do	Do.
Union, Presbyterian church		52	18.87		08	09.16	do	Do.
		43	44.08		14	43.81	do	Do.
Springs Hotel, window in		47	52.00		36	49.00	do	Rept. '83.
ker		59	39.86		54	25.79	do	Do.
Hill		44	06.07		02	09.33	do	Rept. '87.
ville, Baptist church tower		45	26.19		19	51.30	do	Do.
		48	42.42		33	26.66	dc	Do.
Arabia:								
tch Reformed church cupola		56	34.07		33	23.93	do	Do.
heran church tower		56	25.80		33	22.38	do	Do.
t		35	42.94		34	58.73	do	Do.
son		39	23.19		32	10.97	do	Do.
gh		46	19.82		27	31.39	do	Do.
Hill, Presbyterian church r.		57	17.89		17	01.94	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			74°-75°				
	°	′	″	°	′	″		
Turk	42	39	57.92	74	28	08.27	S. S	Rept. '87.
Utsayantho		23	56.21		35	24.12	do	Do.
Van Apse (Abram) barn, cupola		56	24.59		23	34.70	do	Do.
Van Atten		54	18.07		00	15.60	do	Do.
Van Deusen		56	58.10		28	00.29	do	Do.
Vly		14	45.50		26	29.60	G. S	Bull. 122.
Watersheet		51	49.16		04	13.98	S. S	
West Amsterdam, Lutheran church tower.		58	44.26		16	55.77	do	Rept. '87.
Willet		58	32.84		41	29.42	do	Do.
Windham, High Peak		18	53.78		08	36.22	G. S	Bull. 122.
Winne		43	49.55		02	32.48	S. S	Rept. '87.
Yule		56	40.67		53	58.48	do	Do.
	42°-43°			75°-76°				
Babell	42	16	26.13	75	40	51.85	do	Do.
Fenner		57	23.96		44	35.93	do	Do.
Getman		59	19.60		01	43.73	do	Do.
Maine		13	15.35		58	44.80	do	Do.
Solon		37	42.04		59	10.38	do	Do.
Tassel		56	29.13		19	00.47	do	Do.
Windsor		06	10.26		44	47.29	do	Do.
	42°-43°			76°-77°				
Alpine, Methodist Episcopal church	42	18	42.22	76	43	29.08	do	Do.
Ashland		01	54.62		47	01.88	do	Do.
Auburn, court-house dome		55	47.86		34	09.19	do	Do.
Barton		06	48.66		27	29.52	do	Do.
Brown		23	48.31		51	03.44	do	Do.
Burdett:								
Methodist Episcopal church		25	13.81		50	46.94	do	Do.
Presbyterian church		25	00.81		50	50.11	do	Do.
Cafferty		06	30.34		08	03.58	do	Do.
Catharine, Methodist Episcopal church.		18	46.23		46	58.58	do	Do.
Chemung		02	31.64		33	21.02	do	Do.
Clapp		58	11.87		02	19.08	do	Do.
Cortland:								
Baptist church		36	01.32		10	40.69	do	Do.
Normal School, east cupola		35	56.99		10	36.02	do	Do.
Wagon Company's chimney		35	58.38		10	15.94	do	Do.
Couch		17	56.13		48	32.43	do	Do.
Dryden		23	06.00		20	02.00	do	Rept. '83.
Do		28	07.19		20	01.20	do	Rept. '87.
Eddytown, Presbyterian church		31	17.13		55	47.12	do	Do.
Ellis		38	47.65		12	52.41	do	Do.
Elmira:								
First Methodist Episcopal church		05	31.48		48	16.04	do	Do.
First Presbyterian church		05	28.28		48	16.59	do	Do.
Park Congregational church		05	21.45		48	32.97	do	Do.
Female College tower		05	54.21		48	50.68	do	Do.
Public School, No. 5		05	50.54		49	16.47	do	Do.
Richardson shoe factory clock tower.		05	19.32		48	21.18	do	Do.
St. Mary's Roman Catholic church.		04	36.50		48	22.30	do	Do.
St. Patrick's Roman Catholic church.		05	37.81		48	39.30	do	Do.
Trinity Protestant Episcopal church.		05	24.06		48	30.13	do	Do.
Enfield		27	15.48		35	59.22	do	Do.
Erin		10	16.22		37	48.81	do	Do.
Fabius		48	41.63		01	14.88	do	Do.
Giles		53	02.27		26	13.44	do	Do.
Green		59	18.78		01	49.23	do	Do.
Havana:								
Baptist church		20	41.81		50	50.33	do	Do.
Cook Academy		20	30.85		50	22.16	do	Do.
Court-house		20	44.41		50	50.66	do	Do.
Methodist Episcopal church		20	44.58		50	44.23	do	Do.
Presbyterian church		20	43.33		50	37.14	do	Do.
Protestant Episcopal church		20	40.15		50	59.02	do	Do.
Union school-house		20	40.52		50	38.76	do	Do.
Hawley		06	22.99		52	15.73	do	Do.
Hector		26	47.09		48	21.04	do	Do.
Homer:								
Academy cupola		38	08.81		10	48.00	do	Do.
Baptist church		38	04.20		10	48.76	do	Do.
Methodist Episcopal church		38	05.57		10	48.50	do	Do.
Presbyterian church		38	07.38		10	48.18	do	Do.
Hornby		15	42.78		59	38.72	do	Do.
Horseheads		09	59.05		49	32.14	do	Do.

NEW YORK—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	76°-77°		
Horseheads—Continued.	° ′ ″	° ′ ″		
Baptist church	42 09 55.79	76 49 20.03	S. S.	Rept. '87
Methodist Episcopal church	09 58.97	49 20.31	do	Do.
Presbyterian church	09 57.77	49 19.98	do	Do.
Protestant Episcopal church	09 53.23	49 10.50	do	Do.
Howlett	59 52.95	17 26.55	do	Do.
Hoxsie	55 46.15	22 28.30	do	Do.
Hubert	36 42.74	08 40.05	do	Do.
Hungerford	25 45.22	27 03.45	do	Do.
Ithaca:				
Cornell University, barn cupola	26 58.12	28 45.87	do	Do.
McGraw Building	26 57.97	29 08.80	do	Do.
Sage Chapel	26 49.70	29 05.08	do	Do.
Sage College	26 45.24	29 02.06	do	Do.
Light-house dome	27 44.92	30 52.70	do	Do.
McGraw Fiske, house	27 03.28	29 18.29	do	Do.
Presbyterian church	26 32.12	29 56.93	do	Do.
Protestant Episcopal church	26 28.27	29 58.42	do	Do.
Roman Catholic church	26 24.64	30 03.15	do	Do.
Sprague fire-engine house, flag pole.	26 22.04	30 36.68	do	Do.
State Street Methodist Episcopal church.	26 22.57	30 07.79	do	Do.
Jacksonville, Methodist Episcopal church.	30 44.74	38 06.62	do	Do.
Kile	04 34.65	15 41.46	do	Do.
Maby	07 32.60	47 38.02	do	Do.
Mathews	07 30.65	50 34.80	do	Do.
Mitchel	56 35.05	31 46.27	do	Do.
Morehead	32 22.71	13 27.39	do	Do.
Moreland, Presbyterian church	18 28.25	54 34.67	do	Do.
Newfield	23 11.24	40 10.62	do	Do.
Niles	47 56.73	26 03.55	do	Do.
North Barton church	07 07.00	29 39.00	do	Rept. '83.
Oak Hill, Baptist church	05 21.90	27 07.62	do	Rept. '87.
Odessa:				
Free Will Baptist church	20 06.85	47 25.02	do	Do.
Wesleyan Methodist church	20 03.81	47 24.89	do	Do.
Orange	19 11.29	58 27.15	do	Do.
Ovid	40 43.43	49 18.22	do	Do.
Owego, court-house	42 06.08	15 47.00	do	Rept. '83.
Pompey Hill:				
Presbyterian church	53 58.97	00 57.34	do	Rept. '87.
Roman Catholic church	54 03.52	00 48.18	do	Do.
Reading Center:				
Baptist church	25 49.60	56 00.75	do	Do.
Methodist Episcopal church	25 51.36	56 00.99	do	Do.
Richford	23 47.15	13 20.84	do	Do.
Ripley	47 24.85	14 26.42	do	Do.
Rock Stream, church	28 19.94	55 45.06	do	Do.
Ross Hill, church	05 08.00	25 30.00	do	Rept. '83.
Seeley	58 33.42	22 11.68	do	Rept. '87.
Shafford, church	48 15.00	15 56.00	do	Rept. '83.
South Hill	25 49.04	29 45.28	do	Rept. '87.
Strader	21 41.50	52 03.36	do	Do.
Sugar Hill, Presbyterian church	21 45.13	59 26.03	do	Do.
Trumansburg:				
Baptist church	32 34.84	39 43.53	do	Do.
Methodist Episcopal church	32 26.06	39 30.10	do	Do.
Presbyterian church	32 28.63	39 33.00	do	Do.
Protestant Episcopal church	32 27.01	39 40.02	do	Do.
Turner	25 07.71	29 38.70	do	Do.
University	26 54.15	29 08.73	do	Do.
Van Dorns Corners, Methodist Episcopal church.	26 53.92	34 29.77	do	Do.
Virgil	29 34.06	08 24.95	do	Do.
Watkins:				
Academy	22 37.80	52 09.33	do	Do.
Court-house	22 36.50	52 16.49	do	Do.
Lake View Hotel	22 42.38	52 39.24	do	Do.
Methodist Episcopal church	22 50.90	52 20.53	do	Do.
Palmater's (O.) house	23 59.99	51 03.21	do	Do.
Presbyterian church	22 48.03	52 15.43	do	Do.
Protestant Episcopal church	22 47.89	52 16.56	do	Do.
Roman Catholic church	22 39.56	52 12.21	do	Do.
Watkins Glen observatory	22 33.40	52 29.73	do	Do.
West Dryden, church	31 02.21	24 54.07	do	Do.
White	08 30.17	29 18.65	do	Do.
	42°-43°	77°-78°		
Bristol	42 42 00.62	77 24 31.05	do	Do.
Gorham	48 54.11	10 54.82	do	Do.
Milo	35 16.32	01 46.62	do	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			77°-78°				
	°	′	″	°	′	″		
Scottsville	42	59	59.29	77	42	37.59	L. S	Final Rept.
Sproul		23	13.77		00	10.51	S. S	Rept. '87.
Swale		12	16.23		29	28.02	do	Do.
Urbana		25	40.54		15	14.99	do	Do.
Worden		44	46.66		25	34.22	do	Do.
	42°-43°			78°-79°				
Batavia:								
Court-house dome	42	59	51.75	78	11	13.19	do	Do.
German Methodist Episcopal church spire.		59	45.29		10	56.40	do	Do.
Johnston Harvester Works, chimney.		59	36.26		10	25.84	do	Do.
Methodist Episcopal church spire		59	50.66		10	53.59	do	Do.
Presbyterian church tower		59	47.93		10	45.62	do	Do.
Buffalo		53	03.18		52	41.83	L. S	Final Rept.
Buffalo Plains		56	58.22		49	03.79	do	Do.
East base		59	19.57		48	32.98	do	Do.
Erie County:								
Buffalo light-house		52	40.10		53	24.00	do	Do.
Horseshoe light-house		52	52.50		54	56.20	do	Do.
Intersection of Michigan and Exchange streets, Buffalo.		52	41.10		52	14.30	do	Do.
Hamburg		46	50.61		51	31.92	do	Do.
Norris		50	23.95		06	56.96	S. S	Rept. '87.
Richmond		35	16.65		52	37.69	G. S	Bull. 122.
West Base		57	20.56		52	44.54	L. S	Final Rept.
	42°-43°			79°-80°				
Barcelona	42	20	32.00	79	35	24.40	do	Do.
Brocton		24	07.00		28	41.80	do	Do.
Dunkirk:								
Chimney of Brook's Locomotive Works.		29	06.40		19	26.80	do	Do.
Light-house		29	37.80		21	15.80	do	Do.
New light-house		29	44.30		21	25.80	do	Do.
Dean		32	33.61		09	15.62	G. S	Bull. 122.
Deering		25	49.50		14	19.03	do	Do.
Pierce		26	06.00		09	18.82	do	Do.
Prospect		19	29.50		29	59.60	L. S	Final Rept.
Sheffin		36	38.41		00	30.72	G. S	Bull. 122.
Silver Creek		31	13.94		13	27.81	L. S	Final Rept.
Sturgeon Point		41	24.88		02	53.93	do	Do.
Westfield		16	25.30		37	30.71	do	Do.
High School		19	29.70		34	23.20	do	Do.
Methodist Episcopal church		19	26.50		34	33.20	do	Do.
	41°-42°			71°-72°				
Chocomount	41	16	48.06	71	57	48.05	C. & G. S	Do.
Montauk		03	54.39		54	18.43	do	
Montauk, 2		03	54.38		54	18.50	do	Rept. '85.
	41°-42°			72°-73°				
Brown Hill	41	09	11.29	72	17	36.46	do	Do.
Great Gull Island		12	06.43		07	06.21	do	Do.
Horton Point		04	58.21		26	53.61	do	Do.
Mattituck Hills		00	08.46		34	29.75	do	Do.
Mount Prospect		15	21.51		00	35.93	do	Do.
Mount Prospect, 2		15	21.54		00	35.87	do	Do.
Shelter Island		04	38.99		21	39.79	do	Do.
	41°-42°			73°-74°				
Bailey	41	18	43.79	73	33	06.07	do	Do.
Bald Hill		30	05.88		55	03.94	do	Do.
Bancroft		33	41.11		31	42.69	do	Do.
Barnes		48	14.31		51	00.74	do	
Bingham		35	31.24		59	31.60	do	
Boice		55	54.81		49	31.30	G. S	Bull. 122.
Brace Mountain, monument		02	39.91		29	34.88	C. & G. S	
Briggs		34	35.88		31	49.10	do	
Bussing		09	36.33		40	47.58	do	
Buttermilk		06	36.44		48	38.90	do	
Chapel Light		43	08.30		31	07.20	do	
Clark monument		48	02.69		30	27.96	do	
Clove		41	18.57		41	36.06	do	
Corner Stone		02	58.38		29	15.96	do	
Dickerson		15	32.13		52	02.38	do	
East Bluff		56	21.21		28	18.02	do	
Fields West		02	17.38		43	34.48	do	
Golden Ridge		38	44.88		59	08.31	do	
Haines		54	37.74		34	08.07	do	
Hamlin		59	10.51		32	48.90	do	
High Tor		11	15.51		57	56.65	do	
Hook Mountain		07	27.34		54	43.15	do	
Hussey Hill		53	08.54		59	40.69	G. S	Do.

NEW YORK—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	41°-42°			73°-74°				
	°	′	″	°	′	″		
Iron bolt, near 30 mile boundary stone	41	43	08.36	73	30	51.65	C. & G. S	
Kingston City Hall		55	37.46		59	47.90	G. S	Bull. 122.
Lewisboro, Presbyterian church (1865).		16	24.03		33	17.57	C. & G. S	
Lloyd		49	17.24		53	14.19	do	Do.
Merwin		14	09.09		19	57.60	do	
Monument stone		34	24.64		31	35.87	do	
Osborne		35	16.90		32	29.32	do	
Plymouth		46	25.41		37	17.28	do	
Port Chester		00	09.16		40	22.77	do	
Poughkeepsie		41	18.00		53	24.00	do	
Preston		42	36.70		31	04.37	do	
Prospect		52	27.96		57	49.92	do	Do.
Purdy		03	10.12		41	36.08	do	
Ridgefield Angle, monument stone		17	42.68		33	06.79	do	
Round Mountain		25	06.37		32	25.65	do	
Monument		25	11.91		32	20.53	do	
Sandford		01	13.46		39	56.96	do	
Spencers Corner, spire (1863)		57	45.62		30	08.69	do	
Stewart		46	13.66		58	09.96	do	
Stratford Shoal (Middle Ground) light-house (1881-1885).		03	35.78		06	06.11	do	
Terry		56	22.29		58	19.53	do	Do.
Traver		55	05.04		52	41.44	do	
Underhill		35	47.39		51	56.70	do	
Vervalin		41	21.52		50	54.79	do	
Warner		24	04.88		56	33.99	do	
Watermelon		21	53.81		43	16.37	do	
Wilton monument		12	46.07		28	56.40	do	
Wing monument stone		33	30.38		31	40.71	do	
	41°-42°			74°-75°				
Pink	41	54	04.50	74	02	46.89	G. S	
Prospect Hill		33	21.83		01	48.68	C. & G. S	
Schuyler		58	54.73		26	35.72	S. S	
Sky Top Tower		45	49.76		09	23.64	G. S	Do.
Slide		59	56.97		23	10.94	do	Do.

NEW JERSEY.

	41°-42°			74°-75°				
	°	′	″	°	′	″		
Allendale church spire	41	01	49.56	74	07	34.74	C. & G. S	Final Rept., Vol. 1.
Bald Mountain		07	14.54		12	02.91	do	Do.
Beach Mountain		10	00.16		17	40.09	do	Do.
Bear Fort		08	26.15		23	31.50	do	Do.
Beaver Run		09	21.00		38	46.77	do	Do.
Catfish Pond, summit, east of pond		01	57.42		59	50.19	do	Do.
Centerville		12	54.07		50	29.59	do	Do.
Culver Gap		10	20.99		47	42.03	do	Do.
Darlington		04	42.70		12	32.80	do	Do.
Decker Pond		12	14.34		32	02.25	do	Do.
Deckertown, Presbyterian church spire.		12	39.10		36	23.47	do	Do.
Dunker Pond		04	58.50		28	57.03	do	Do.
East and west Jersey line (on Blue Mountain).		08	46.65		50	59.68	do	Do.
Franklin furnace stack		06	32.22		35	21.34	do	Do.
Glenwood		15	27.31		30	17.51	do	Do.
Hamburg		08	53.35		31	49.78	do	Do.
High Point		19	15.24		39	42.98	do	Do.
High Torne		09	05.39		09	47.33	do	Do.
Lafayette		07	53.51		41	26.76	do	Do.
Macopin		02	56.21		24	03.59	do	Do.
Newton, Presbyterian church spire		03	27.30		45	18.60	do	Do.
Ramsey, church tower		03	33.61		08	32.10	do	Do.
Smith Hill		04	57.55		44	49.77	do	Do.
Sparta		00	58.46		38	15.64	do	Do.
Waykoff, church cupola		00	27.73		10	25.98	do	Do.
Woodport		00	40.05		35	29.96	do	Do.
	40°-41°			73°-74°				
Cherry Hill	40	54	45.91	73	58	12.17	do	Do.
Coytesville		51	37.59		58	45.27	do	Do.
Duer		59	53.46		54	10.37	do	Do.
Englewood		53	28.16		58	16.05	do	Do.
Fort Lee, flagstaff		50	49.00		57	53.76	do	Do.
Navesink		23	47.86		59	09.67	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			73°-74°				
	°	′	″	°	′	″		
Navesink	40	23	18.14	73	59	13.40	C. & G. S	Final Rept., Vol. 1.
Lighthouse		23	45.23		59	08.52	do	Do.
Palisade		59	52.93		54	17.49	do	Do.
Schraalenburg, church spire		56	25.10		59	40.05	do	Do.
State line, stone on bank of Hudson River.		54	50.10		55	28.95	do	Do.
	40°-41°			74°-75°				
Allentown, Reformed church spire	40	10	27.10	74	35	14.60	do	Do.
Andover		59	09.80		44	49.40	do	Do.
Aquackanonck		51	03.73		07	45.60	do	Do.
Arney		00	28.66		42	12.62	do	Do.
Baird		14	09.85		24	51.16	do	Do.
Bald Hill		57	39.81		21	03.61	do	Do.
Banta		53	12.54		00	59.46	do	Do.
Bay Way, Staten Chemical Co.'s chimney.		37	56.00		12	15.30	do	Do.
Bayard		35	01.66		12	43.94	do	Do.
Beacon Hill		22	26.55		13	41.91	do	Do.
Bedminster, church cupola		40	14.70		38	43.00	do	Do.
Beers Hill		23	33.76		11	26.19	do	Do.
Bergen, Dutch Reformed church		43	37.14		04	04.35	do	Do.
Bergen Fields, church spire		55	45.64		00	13.18	do	Do.
Bergen Neck		45	52.00		02	36.50	do	Do.
Bergen Point, spire		38	52.17		07	30.14	do	Do.
Bird		39	05.83		10	28.39	do	Do.
Bishop's barn		03	47.40		41	38.00	do	Do.
Bloomfield		32	06.71		19	28.84	do	Do.
Boonton, Presbyterian church spire		54	23.52		24	37.38	do	Do.
Bordentown, flag pole		08	52.95		42	49.59	do	Do.
Bordentown, Presbyterian church spire.		08	36.50		42	37.10	do	Do.
Bordentown Observatory		09	20.57		42	43.74	do	Do.
Bordentown, church spire		08	48.70		42	50.10	do	Do.
Bound Brook		34	59.36		31	57.27	do	Do.
Boynton's Tile Works, near Woodbridge Landing.		32	26.58		15	21.56	do	Do.
Burdge		23	02.23		01	45.70	do	Do.
Burlington, St. Mary's spire		04	37.80		51	43.60	do	Do.
Bury		50	28.80		05	22.41	do	Do.
Caldwell, church spire		50	20.98		16	33.92	do	Do.
Caldwell		50	24.29		15	24.67	do	Do.
Do		50	24.10		15	24.70	do	Do.
Carhart		25	03.93		02	31.56	do	Do.
Caven Point		41	33.96		04	18.97	do	Do.
Centerville, church spire		40	05.83		06	53.16	do	Do.
Chapel Hill, back light		23	53.80		03	32.66	do	Do.
Chapel Hill, light-house pole		23	54.48		03	32.57	do	Do.
Cherryville, spire		33	44.70		54	15.50	do	Do.
Cherryville		33	45.15		54	31.01	do	Do.
Chestnaquack		27	40.13		15	03.39	do	Do.
Chestnaquack Point		27	39.58		15	02.36	do	Do.
Christopher		04	13.42		11	56.75	do	Do.
Claybanks		07	14.42		47	53.03	do	Do.
Cold Soil		20	40.64		42	33.50	do	Do.
Columbus, west spire		04	25.00		43	31.40	do	Do.
Compton		26	22.54		05	29.84	do	Do.
Conasconck Point		27	33.40		10	44.64	do	Do.
Conover		20	41.08		01	27.32	do	Do.
Conover beacon		25	17.01		03	21.29	do	Do.
Constable Point		39	26.12		05	45.51	do	Do.
Cornhill		22	23.78		54	42.70	do	Do.
Cranbury:								
First Presbyterian church steeple		18	26.38		31	08.32	do	Do.
Second Presbyterian church spire		18	50.40		30	51.60	do	Do.
Crane		50	08.02		13	08.76	do	Do.
Cranford, Presbyterian church spire		39	28.10		18	11.60	do	Do.
Crosswick, spire		09	16.30		39	02.10	do	Do.
Croton		29	04.12		54	45.55	do	Do.
Cushetunk		37	24.80		48	26.90	do	Do.
Danville		52	12.03		56	12.86	do	Do.
Dayton, church spire		22	32.80		30	43.70	do	Do.
Debow hill		10	58.17		25	36.79	do	Do.
Delanco		02	46.15		57	46.20	do	Do.
Delanco, church spire		02	58.11		57	25.15	do	Do.
Disboro Hill		14	48.23		27	26.00	do	Do.
Dunellen, spire		35	39.90		27	50.20	do	Do.
Dutch Neck, spire		16	57.50		36	50.30	do	Do.
East and west Jersey line		53	49.06		44	54.13	do	Do.
East Millstone, Reformed church cupola.		30	10.14		34	47.35	do	Do.
East Trenton, Rubber Works chimney		14	23.00		43	39.00	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			74°-75°				
Elizabeth:	°	′	″	°	′	″		
First Presbyterian church spire	40	39	45.60	74	12	56.80	C. & G. S	Final rept., Vol. 1.
St. Mary's church spire		39	29.90		13	07.80	do	Do.
Elizabethport Oil Cloth Co.'s chimney.		38	45.96		11	45.84	do	Do.
Elizabethport, spire Presbyterian church.		38	52.45		11	27.94	do	Do.
Elizabethtown, spire First Presbyterian church.		39	45.54		12	56.67	do	Do.
Ewing, church spire		16	14.40		48	02.50	do	Do.
Fairfield, spire Reformed church		53	04.54		16	58.03	do	Do.
Fleming		00	15.97		03	31.97	do	Do.
Flemington, spire Methodist church		30	20.23		51	30.22	do	Do.
Florence, foundry chimney		07	31.10		49	05.60	do	Do.
Fox Hill		43	59.01		48	19.05	do	Do.
Freehold, spire old court-house		15	37.18		16	28.40	do	Do.
Freehold, spire Reformed church		15	28.00		16	42.40	do	Do.
Garriell		20	34.44		03	05.72	do	Do.
Gibbet Island		41	58.32		02	25.39	do	Do.
Goat Hill		20	44.75		56	17.05	do	Do.
Grandon Hill		15	47.42		13	55.76	do	Do.
Green Island		00	35.22		06	26.49	do	Do.
Green Pond		58	33.64		32	01.63	do	Do.
Hackensack, church spire		53	18.55		02	32.65	do	Do.
Hackettstown		51	08.08		52	19.41	do	Do.
Hamilton Square, Baptist church		13	46.10		39	37.30	do	Do.
Hardwick, church cupola		59	44.10		51	39.00	do	Do.
Harrison House, cupola		02	22.67		59	47.93	do	Do.
Hawk		33	41.77		14	25.40	do	Do.
Do		02	35.95		58	39.21	do	Do.
Hazel's farm		18	05.57		40	28.29	do	Do.
High Mountain		58	14.12		11	55.38	do	Do.
Highwood		46	12.70		01	02.06	do	Do.
Highland of Squan		06	10.48		04	37.60	do	Do.
Hilton		25	19.99		03	29.34	do	Do.
Hope, church spire		54	31.90		58	11.70	do	Do.
Hunter House, north chimney		00	47.91		59	07.46	do	Do.
Jenny Jump Mountain		52	02.20		59	20.80	do	Do.
Jersey City:								
Spire		42	53.18		02	16.75	do	Do.
Flagstaff		42	55.03		02	17.10	do	Do.
Key East Hotel, flagstaff		11	29.60		00	37.80	do	Do.
Keyport, spire		26	15.21		12	07.14	do	Do.
Kill von Kull Oil Cloth Co.'s chimney.		39	18.82		06	33.44	do	Do.
Kills Light, Bergen Point		38	34.83		08	55.74	do	Do.
King		01	21.05		56	29.70	do	Do.
Kingsland		47	47.76		07	32.55	do	Do.
Lamington, church spire		39	38.20		43	12.20	do	Do.
Lawrenceville		18	07.81		44	08.31	do	Do.
Standpipe		17	31.90		44	10.90	do	Do.
Spire		17	53.80		43	44.85	do	Do.
Liberty pole, Long Branch village		17	58.35		00	12.20	do	Do.
Light-house flag		26	53.55		07	16.71	do	Do.
Linden, spire Episcopal church		37	39.70		15	07.00	do	Do.
Linden, spire Reformed church		38	02.60		15	32.20	do	Do.
Lippincott, hill		15	20.43		07	49.81	do	Do.
Mapleton		21	11.42		36	43.43	do	Do.
Matayan		26	51.67		12	38.80	do	Do.
Matayan Point		26	53.08		12	39.43	do	Do.
Mechanicsville, church spire		37	11.20		45	00.40	do	Do.
Menlo Park, tall iron stack		33	49.00		20	22.50	do	Do.
Metuchen, spire Presbyterian church		32	25.70		21	34.50	do	Do.
Middlebush, church spire		29	49.87		31	42.81	do	Do.
Midland Park, church tower		59	26.80		08	31.60	do	Do.
Mine Mount		43	19.05		36	20.28	do	Do.
Morgan		28	03.76		15	59.33	do	Do.
Do		28	10.75		15	56.15	do	Do.
Do		28	07.88		15	53.80	do	Do.
Morristown, spire Presbyterian church.		47	50.43		28	49.89	do	Do.
Mount Canoe		19	40.56		51	39.58	do	Do.
Mount Holly		00	09.12		47	19.30	do	Do.
Mount Horeb		36	42.07		34	16.27	do	Do.
Mount Mitchell, north edge of Highlands.		24	30.57		00	26.20	do	Do.
Mount Olive		52	02.48		42	52.50	do	Do.
Mount Rose		22	03.36		43	25.74	do	Do.
Netherwood		37	33.70		24	00.40	do	Do.
New Brunswick:								
Rutgers College cupola		29	55.43		26	48.12	do	Do.
Spire St. James		29	38.00		26	53.30	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			74°-75°				
	°	′	″	°	′	″		
New Dover, spire	40	35	07.20	74	20	26.40	C. & G. S	Final rept., Vol. 1.
Newark:								
Spire Methodist church		44	06.18		10	12.50	do	Do.
Spire First Presbyterian church		44	03.78		10	22.16	do	Do.
Spire Episcopal church		44	25.42		10	10.35	do	Do.
Bay light or Passaic light		41	46.29		07	39.13	do	Do.
Bay beacon		42	08.20		07	27.87	do	Do.
Neck		42	47.57		08	19.90	do	Do.
Newell		11	43.95		14	25.67	do	Do.
North Branch		35	55.35		40	53.28	do	Do.
Spire Reformed church		35	56.60		40	22.20	do	Do.
Ocean Beach, Colorado House		10	23.80		00	57.50	do	Do.
Ocean House, flagstaff		22	54.54		58	33.80	do	Do.
Palmerpaw		40	40.84		05	59.22	do	Do.
Paramus, church spire		59	07.12		05	33.28	do	Do.
Parsippany, church spire		51	52.70		24	24.20	do	Do.
Parsippany, spire Presbyterian church.		51	52.77		24	23.87	do	Do.
Passionist Fathers' Monastery, West Hoboken.		45	56.98		02	12.18	do	Do.
Pennington Seminary, cupola		19	38.16		47	37.90	do	Do
Perth Amboy, spire Episcopal church		30	13.34		15	56.15	do	Do.
Perth Amboy, Presbyterian church		30	20.79		15	57.80	do	Do.
Pickles		35	40.96		49	26.17	do	Do.
Pigeon Hill		24	27.90		04	43.23	do	Do.
Pleasant Corner, church spire		26	28.63		51	24.15	do	Do.
Pluckamin, church spire		38	52.60		38	32.50	do	Do.
Plum		01	56.99		59	26.61	do	Do.
Point Comfort		27	23.59		08	04.95	do	Do.
Polhemus		19	02.80		08	56.52	do	Do.
Poplar Ridge		22	17.10		42	30.35	do	Do.
Pottersville		42	24.80		44	06.10	do	Do.
Powder Mills, machine-shop chimney		55	30.11		16	33.39	do	Do.
Princeton College, cupola		20	54.86		39	34.86	do	Do.
Do		20	55.00		39	35.10	do	Do.
Princeton Seminary, cupola		20	42.80		39	53.86	do	Do.
Princeton water tower		20	23.50		40	03.50	do	Do.
Quakertown, spire		33	52.90		56	31.50	do	Do.
Rahway, spire First Presbyterian church.		36	31.80		16	34.10	do	Do.
Do		36	53.74		16	51.81	do	Do.
Do		36	53.80		16	51.80	do	Do.
Rancocas		02	36.10		58	40.44	do	Do.
Randolph		36	44.51		23	40.02	do	Do.
Raritan woolen mill chimney		33	54.72		37	57.02	do	Do.
Readington, spire Reformed church		34	05.16		44	09.19	do	Do.
Readington, church spire		34	05.20		44	09.20	do	Do.
Red Bog		14	06.08		03	14.06	do	Do.
Do		14	05.81		03	13.71	do	Do.
Robbins Reef light		39	26.45		03	56.68	do	Do.
Roselle, flagstaff		39	37.00		15	50.40	do	Do.
Rosemont, spire		25	39.40		59	26.40	do	Do.
Rowan		38	54.14		07	33.62	do	Do.
Sand Ridge, spire Baptist church		25	23.15		57	14.59	do	Do.
Sandhills		24	30.00		32	39.08	do	Do.
Sandy Hook		27	44.98		00	24.70	do	Do.
Signal		28	19.85		00	23.11	do	Do.
Light-house		27	42.29		00	08.46	do	Do.
Sawyer, Tufts Point		33	38.86		13	26.27	do	Do.
Sayre, hill		40	46.26		17	17.28	do	Do.
Schooley Mountain		49	47.53		47	33.15	do	Do.
Schuyler		46	48.88		08	30.07	do	Do.
Sea Girt, Beach House, north flagstaff		07	34.80		01	49.90	do	Do.
Seward		28	55.60		16	33.05	do	Do.
Hill		47	12.80		40	35.20	do	Do.
Sewaren		32	47.50		15	18.54	do	Do.
Sheep Hill		55	09.18		24	24.05	do	Do.
Shooter's Island		38	36.84		09	39.94	do	Do.
Chimney		38	32.58		09	39.70	do	Do.
Shotwell		32	48.13		15	21.06	do	Do.
Shrewsbury, spire		19	25.00		03	41.53	do	Do.
Springfield		41	22.14		21	25.14	do	Do.
Somerville, spire First Reformed church.		34	06.48		36	41.42	do	Do.
South Amboy, depot Pennsylvania R. R.		29	29.02		16	35.58	do	Do.
Do		28	47.31		17	19.98	do	Do.
Sourland		25	51.66		45	39.10	do	Do.
Standard Chemical Co., chimney		36	54.00		12	21.73	do	Do.
State Reform School, tower		20	35.60		23	55.60	do	Do.
Staten Chemical Co., chimney		37	55.90		12	15.47	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			74°-75°				–
	°	′	″	°	′	″		
Stelton, church spire	40	31	01.50	74	24	26.00	C. & G. S	Final Rept., Vol. 1.
Stevens		44	41.09		01	26.44	do	Do.
Do		44	41.14		01	26.44	do	Do.
Taylor Mount		02	03.60		33	01.90	do	Do.
Terhune		51	40.71		04	56.66	do	Do.
Three Bridges, church spire		31	23.23		47	49.49	do	Do.
Throckmorton		15	03.90		10	48.57	do	Do.
Tottenville		30	30.90		14	37.90	do	Do.
Tranquility, church spire		56	38.70		48	14.00	do	Do.
Trenton:								
Spire First Presbyterian church		13	13.13		45	49.18	do	Do.
Spire Roman Catholic church		12	51.50		45	40.60	do	Do.
Spire Methodist church		13	13.50		45	36.70	do	Do.
Spire Baptist church		12	41.40		45	36.40	do	Do.
Statehouse dome		13	13.80		46	13.10	do	Do.
Spire, State and Clinton streets		13	16.80		45	21.30	do	Do.
Van Kensen's house, 1 mile south of Newton.		32	16.40		28	06.20	do	Do.
Van Riper		53	36.64		08	24.14	do	Do.
Vanhorne		39	08.23		08	26.70	do	Do.
Vreeland		50	00.72		00	39.47	do	Do.
Wallace		44	33.01		11	15.99	do	Do.
Warrenville		53	53.00		50	21.60	do	Do.
Washington, old chimney, bank of canal.		45	55.60		59	17.20	do	Do.
Washington Hunter		00	55.51		59	08.33	do	Do.
Do		00	55.73		59	16.80	do	Do.
Washington Rock		36	45.70		28	20.90	do	Do.
Watnong		50	55.48		29	39.93	do	Do.
Wayne, chimney powder mill		55	30.10		16	33.50	do	Do.
Weasel		52	36.81		11	12.21	do	Do.
Westfield, spire Presbyterian church		30	14.10		20	52.70	do	Do.
White Hall		42	29.40		54	00.60	do	Do.
White Hill		08	22.49		43	53.26	do	Do.
White Horse		11	13.50		42	27.11	do	Do.
Williams		34	53.88		12	51.94	do	Do.
Wilson		26	21.67		05	28.82	do	Do.
Wilson Beacon		26	38.60		08	11.22	do	Do.
Windsor, spire		14	34.50		34	57.70	do	Do.
Woodbridge		33	25.21		14	40.83	do	Do.
Spire Presbyterian church		33	42.50		16	25.94	do	Do.
Landing		32	45.93		15	19.71	do	Do.
Woodside		03	47.52		49	34.03	do	Do.
Wynant		32	57.98		14	18.59	do	Do.
Do		36	27.11		13	11.48	do	Do.
Zellis		32	45.72		16	37.64	do	Do.
	39°-40°			74°-75°				
Absecon	39	25	12.43	74	29	27.03	do	Do.
Absecon light-house		21	58.74		24	52.27	do	Do.
Apple Pie Hill		48	26.62		35	23.83	do	Do.
Atco		46	17.70		53	08.20	do	Do.
Atsion Mill tower		44	21.50		43	30.60	do	Do.
Balcony		55	27.09		23	40.94	do	Do.
Barnegat Inlet		45	58.47		06	15.43	do	Do.
Barnegat light-house		45	51.61		06	23.78	do	Do.
Barnegat, Methodist church spire		45	09.81		13	20.04	do	Do.
Beasley		17	02.53		37	00.20	do	Do.
Beasley Point		16	50.11		37	41.08	do	Do.
Berlin		48	55.85		54	45.07	do	Do.
Blackman		15	07.94		39	33.53	do	Do.
Blangie		28	44.36		41	16.71	do	Do.
Bridgeway, summit		46	34.43		19	33.26	do	Do.
Brigantine Beach		25	52.68		19	57.31	do	Do.
Brown Mill Observatory		58	09.50		34	53.30	do	Do.
Buckingham		55	57.90		28	30.80	do	Do.
Buena Vista		30	50.60		55	29.70	do	Do.
Cape May, court-house spire		04	53.00		49	29.00	do	Do.
Carlisle		12	06.52		57	07.80	do	Do.
Cedar		13	34.08		38	12.08	do	Do.
Cedar Creek		51	47.44		08	12.94	do	Do.
Cedar Hummock		34	10.58		20	39.31	do	Do.
Corson		12	01.01		39	21.35	do	Do.
Cramer		35	12.24		13	12.76	do	Do.
Cranberry		56	40.21		04	18.55	do	Do.
Crese		03	03.25		49	48.51	do	Do.
Cyrus		04	31.75		44	20.80	do	Do.
Dinner Point		38	00.40		15	14.94	do	Do.
Double Creek		44	27.84		10	40.39	do	Do.
Doughty's tavern		26	53.96		51	46.69	do	Do.
Dry Inlet		20	34.98		28	17.72	do	Do.
Eldridge		06	06.63		47	36.46	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	39°-40°	74°-75°		
	° ′ ″	° ′ ″		
Elwood	39 34 40.33	74 42 55.55	C. & G. S	Final Rept., Vol. I.
English Creek	22 18.30	39 18.30	do	Do.
Estellville	22 21.40	45 44.10	do	Do.
Evesham, summit of Mount Laurel	56 03.45	53 40.41	do	Do.
Fish	18 39.50	32 34.26	do	Do.
Fishing Creek	01 07.28	56 51.86	do	Do.
Forked River	49 22.83	09 28.41	do	Do.
Four Mile	53 08.70	34 11.60	do	Do.
Gibbsboro	50 20.57	56 59.38	do	Do.
Good Luck Point	55 21.58	07 07.10	do	Do.
Goose Creek	57 07.97	06 40.38	do	Do.
Goshen	07 39.64	53 30.63	do	Do.
Gowdy's house, cupola	57 11.73	10 34.90	do	Do.
Great Swamp	40 42.53	08 59.32	do	Do.
Grore	20 03.74	30 17.18	do	Do.
Hammock	07 00.00	53 30.65	do	Do.
Hammonton	38 48.05	49 19.29	do	Do.
Heart	15 34.23	38 35.80	do	Do.
Hickey	37 37.20	11 23.36	do	Do.
Hickory Island	41 14.94	13 03.12	do	Do.
Holmes	07 35.91	46 13.33	do	Do.
Huckleberry	51 24.50	44 15.70	do	Do.
Island Beach	49 05.52	05 28.73	do	Do.
Isle	10 36.65	40 32.66	do	Do.
Jemima, Mount	43 43.00	27 04.10	do	Do.
Kellogg	26 00.50	59 09.80	do	Do.
Leaming Beach, north	06 29.26	42 32.14	do	Do.
Leaming Point	00 59.84	51 18.08	do	Do.
Leed Point	29 02.37	26 00.00	do	Do.
Leedsville	20 55.88	33 39.42	do	Do.
Do	20 56.52	33 40.28	do	Do.
Lewistown, windmill	59 26.90	37 11.70	do	Do.
Limerick	05 43.37	43 23.69	do	Do.
Linwood	20 54.06	33 38.76	do	Do.
Little Egg Harbor light	30 22.11	17 08.32	do	Do.
Long Beach	33 18.89	14 41.23	do	Do.
Ludlam Beach	08 44.70	41 49.29	do	Do.
Ludlam Landing	10 41.75	51 09.74	do	Do.
Do	10 41.66	51 09.60	do	Do.
Marlton, church tower	53 26.30	55 10.70	do	Do.
Marshall	12 13.47	41 47.00	do	Do.
Martha	40 35.87	28 13.12	do	Do.
McCrea	09 52.62	50 45.96	do	Do.
Medford	54 55.30	51 13.50	do	Do.
Miry Run	23 26.50	41 35.60	do	Do.
Moorestown, Episcopal church spire	57 45.27	57 01.69	do	Do.
Mount Laurel	56 03.50	53 39.30	do	Do.
Mountain Creek	11 46.00	39 11.34	do	Do.
Muskee Hill	18 42.20	57 08.20	do	Do.
New Germany	36 26.48	50 49.07	do	Do.
New Inlet	19 12.19	30 50.95	do	Do.
Nummy Island	01 42.70	47 28.91	do	Do.
Ocean	17 18.69	34 13.14	do	Do.
Oyster Creek	30 27.04	24 35.04	do	Do.
Page	59 09.18	07 08.18	do	Do.
Pecks Beach	16 14.97	35 11.12	do	Do.
Peters Beach	23 20.20	24 21.90	do	Do.
Phillip	53 53.37	04 45.90	do	Do.
Pierce Landing	04 57.53	54 25.38	do	Do.
Pine Hill	47 54.03	59 36.00	do	Do.
Piny Hollow	35 09.90	55 39.70	do	Do.
Public	09 03.43	44 48.17	do	Do.
Retreat, hill	53 52.20	41 47.70	do	Do.
Richland	29 18.96	51 12.59	do	Do.
Risley Landing	22 52.45	31 31.79	do	Do.
River	18 23.07	37 12.11	do	Do.
Road	15 05.28	36 53.77	do	Do.
Robinson	11 26.83	59 42.30	do	Do.
Russia	22 46.20	48 32.90	do	Do.
Ryon	22 45.09	31 33.70	do	Do.
Sea	08 59.50	42 15.64	do	Do.
Seaside Park, flagstaff at post-office	55 15.50	04 44.00	do	Do.
Smithville, mill tower	59 10.70	44 54.70	do	Do.
Somers	18 42.68	35 23.39	do	Do.
Somers Point	18 42.48	35 23.25	do	Do.
Stipson	11 54.61	54 37.91	do	Do.
Stipson Island	11 54.67	54 38.00	do	Do.
Stout	57 37.71	04 35.43	do	Do.
Tatham	06 20.34	43 31.72	do	Do.
Taunton, Hunchman's store cupola	51 12.10	51 21.40	do	Do.
Town Bank, hotel cupola	59 14.32	57 30.84	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	39°-40°	74°-75°		
	° ′ ″	° ′ ″		
end	39 10 27.04	74 43 29.58	C. & G. S	Final Rept., Vol. 1.
oe, spire	17 32.40	45 17.60	do	Do.
ton	36 10.16	19 47.82	do	Do.
	10 39.38	43 11.40	do	Do.
ord, spire	43 23.90	51 09.40	do	Do.
sh Creek	13 32.00	37 58.33	do	Do.
Landing	58 58.79	53 09.20	do	Do.
reek	10 30.30	55 04.47	do	Do.
	10 37.79	54 58.35	do	Do.
outh	31 02.18	46 48.46	do	Do.
ck	30 23.50	46 36.00	do	Do.
g's Hotel flagstaff	57 13.04	22 46.62	do	Do.
	13 48.24	40 19.20	do	Do.
	39°-40°	75°-76°		
	39 38 11.81	75 23 04.72	do	Do.
	41 17.34	22 47.66	do	Do.
y	30 15.97	31 48.92	do	Do.
	30 08.53	31 48.25	do	Do.
	23 17.37	25 55.00	do	Do.
	23 17.98	25 59.89	do	Do.
	23 18.03	25 59.93	do	Do.
	23 18.65	25 54.34	do	Do.
	26 19.86	22 05.34	do	Do.
	26 19.96	22 05.40	do	Do.
	17 18.47	17 26.97	do	Do.
vis	17 15.36	17 29.10	do	Do.
and	19 48.71	18 33.48	do	Do.
nnington Hill	36 57.29	21 41.19	do	Do.
ber Creek	52 45.78	08 04.94	do	Do.
sport	51 03.34	14 35.28	do	Do.
land	11 47.61	01 29.58	do	Do.
y Hook light-house	21 49.49	30 38.34	do	Do.
rd Point	15 56.35	11 53.95	do	Do.
ton, Baptist church spire	25 43.20	13 58.10	do	Do.
ton, Chas. R. Elmer's house a.	25 37.20	12 50.50	do	Do.
ton spire	25 46.48	13 57.71	do	Do.
	25 10.71	13 36.54	do	Do.
	31 48.94	22 52.80	do	Do.
	23 59.79	15 43.25	do	Do.
	47 31.54	13 19.13	do	Do.
n	56 44.06	07 29.69	do	Do.
ille	20 38.48	11 50.65	do	Do.
re	20 01.99	12 07.72	do	Do.
ton	31 45.30	07 44.40	do	Do.
r (opposite)	49 43.37	20 39.64	do	Do.
Hill	48 16.99	10 01.68	do	Do.
Landing Point	39 39.95	31 20.27	do	Do.
n, church	39 26.29	05 29.73	do	Do.
ey light-house (old)	20 21.49	21 36.88	do	Do.
s Point	57 15.64	07 42.22	do	Do.
	26 13.73	28 18.14	do	Do.
reek	50 39.50	17 39.73	do	Do.
wn	36 05.20	15 37.20	do	Do.
	22 40.55	20 31.34	do	Do.
	21 47.78	20 13.07	do	Do.
	21 47.65	20 12.97	do	Do.
ld	32 32.20	13 24.20	do	Do.
g Creek	15 20.22	05 23.72	do	Do.
Beach	20 36.34	22 10.63	do	Do.
Neck	23 24.10	15 13.00	do	Do.
ove	16 06.54	13 42.42	do	Do.
sland	17 49.26	14 27.10	do	Do.
Point	52 42.34	10 00.69	do	Do.
oint	11 31.62	01 17.70	do	Do.
and	10 25.07	08 05.52	do	Do.
ht-house	10 43.82	08 13.22	do	Do.
nt	10 26.63	08 08.40	do	Do.
Point	12 42.86	02 51.93	do	Do.
ge Hill	39 45.30	18 24.30	do	Do.
	38 22.75	23 56.45	do	Do.
	34 57.50	11 12.70	do	Do.
	22 13.17	09 09.39	do	Do.
ro	32 26.33	32 03.54	do	Do.
	32 27.48	32 03.46	do	Do.
ro Point, in old Swedish fort	32 24.94	32 03.81	do	Do.
	22 33.37	13 12.26	do	Do.
	22 13.90	09 09.60	do	Do.
ew	58 28.13	03 56.89	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
False Egg Point	39	12	01.23	75	10	11.92	C. & G. S	Final Rept., Vol. 1.
Finn Point		36	00.15		33	02.57	do	Do.
Do		36	01.31		33	05.32	do	Do.
Fish club, flagstaff		53	16.54		07	43.82	do	Do.
Fish cove		58	23.87		03	53.17	do	Do.
Flax Farm		16	36.52		13	13.95	do	Do.
Fort Mifflin		52	31.67		12	45.28	do	Do.
Fortesque		14	12.65		10	19.60	do	Do.
Do		14	07.19		10	16.10	do	Do.
Big flagstaff		14	15.38		10	14.22	do	Do.
Pavilion flagstaff		14	12.23		10	19.14	do	Do.
Garrison		23	36.88		13	22.47	do	Do.
Glassboro, white spire		42	00.70		06	46.70	do	Do.
Gloucester Point		53	49.18		07	46.86	do	Do.
Greenwich		23	27.61		20	41.20	do	Do.
Haddonfield		52	53.37		02	23.30	do	Do.
Do		53	59.30		01	45.70	do	Do.
Hann		25	27.09		15	26.63	do	Do.
Harris		25	10.11		17	35.77	do	Do.
Hawkins		25	35.42		20	40.87	do	Do.
Heusted		22	58.36		18	58.15	do	Do.
Horner		57	40.85		05	42.31	do	Do.
Iona		36	10.20		04	38.20	do	Do.
Isaac		50	47.94		15	42.77	do	Do.
Jacob Creek		21	40.07		23	38.25	do	Do.
Jericho		29	19.80		21	50.20	do	Do.
Jocelyne		18	40.25		08	23.09	do	Do.
John Dayre		26	23.79		12	46.93	do	Do.
Kaighn Point		55	45.96		07	52.54	do	Do.
Kinsey		38	06.31		33	22.14	do	Do.
Laurel		26	21.44		13	43.04	do	Do.
Lippincott		43	20.56		18	49.81	do	Do.
Mahon River light-house		10	19.50		24	02.83	do	Do.
Man Island		50	22.77		19	27.99	do	Do.
Marcus Hook (opposite)		47	42.17		24	21.57	do	Do.
Mathew		51	19.64		12	42.73	do	Do.
Maurice River light-house		11	45.23		01	39.53	do	Do
Maurice River (west)		19	43.20		02	53.16	do	Do.
Merchantville, east spire		57	00.60		02	57.00	do	Do.
Mickle		54	40.31		07	22.47	do	Do.
Millville, standpipe		24	15.10		02	52.70	do	Do.
Morris		59	23.70		02	36.51	do	Do.
Morris Hill		59	24.78		02	36.76	do	Do.
Mount Pleasant		23	25.17		15	22.30	do	Do.
Mulford Landing		22	21.10		19	26.00	do	Do.
Nan		16	40.53		14	46.80	do	Do.
Nantuxent		16	36.81		14	45.49	do	Do.
New		24	09.65		26	35.13	do	Do.
New Boston		31	17.90		17	10.20	do	Do.
Newfield		32	13.84		00	16.13	do	Do.
Ogden		22	06.57		15	28.23	do	Do.
Oldman Creek		47	04.94		25	52.51	do	Do.
Oldman Point		45	40.44		27	41.32	do	Do.
Pine Mount		25	03.79		20	15.94	do	Do.
Pot		29	06.11		31	27.73	do	Do.
Port Norris		14	36.29		01	17.09	do	Do.
Powder Wharf		54	13.47		08	03.23	do	Do.
Red Bank flagstaff		52	20.45		11	20.99	do	Do.
Reedy Island light-house		30	03.37		34	08.76	do	Do.
Reeves		39	06.58		23	05.60	do	Do.
Robbin		44	34.39		20	02.15	do	Do.
Roman Catholic Seminary		29	43.26		01	37.26	do	Do.
Round		25	36.85		27	39.52	do	Do.
Round Island		25	21.99		27	33.14	do	Do.
Do		25	22.02		27	33.17	do	Do.
Do		25	27.04		27	36.01	do	Do.
Salem:								
Presbyterian church spire		34	24.10		27	59.28	do	Do.
Episcopal church spire		34	28.62		27	57.38	do	Do.
Scull		43	33.11		20	42.13	do	Do.
Do		40	59.77		20	52.29	do	Do.
Sea Breeze, Warner House flagstaff		19	26.71		19	14.83	do	Do.
Sheppard		22	41.43		21	22.81	do	Do.
Ship John light-house		18	19.10		22	37.08	do	Do.
Sneed		27	32.96		31	01.94	do	Do.
Stony		27	47.42		31	12.55	do	Do.
Do		28	01.83		31	16.12	do	Do.
Stony Point		27	33.09		31	09.25	do	Do.
Stow		22	50.27		24	51.89	do	Do.
Stringtown		40	13.30		14	18.80	do	Do.
Swedesboro, spire Episcopal church		45	02.04		18	26.72	do	Do.

NEW JERSEY—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			75°-76°				
	°	′	″	°	′	″		
son Point	39	50	34.93	75	18	23.90	C. & G. S	Final Rept., vol. 1.
		58	45.36		05	14.26	do	Do.
		13	46.84		00	09.58	do	Do.
Island		49	14.50		22	00.34	do	Do.
		48	52.06		22	50.68	do	Do.
		12	36.04		02	43.10	do	Do.
Point		14	59.23		07	41.06	do	Do.
d, church		29	10.17		01	16.12	do	Do.
		45	39.83		12	20.01	do	Do.
oint		19	06.31		15	30.23	do	Do.
n		23	29.83		19	25.40	do	Do.
oint		57	28.27		05	38.73	do	Do.
ury Creek		51	53.13		11	52.75	do	Do.
ff		24	49.75		08	47.25	do	Do.
ay:	38°-39°			74°-75°				
light-house	38	55	51.84	74	57	58.50	do	Do.
light-house		55	53.62		57	35.17	do	Do.
ss Hall		55	54.21		55	29.37	do	Do.
		57	17.32		57	51.55	do	Do.
le Beach		57	29.33		50	59.70	do	Do.
Landing		58	58.79		52	69.20	do	Do.

PENNSYLVANIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			79°-80°				
	°	′	″	°	′	″		
Creek, Erie County	42	12	03.70	79	56	35.00	L. S	Final Rept.
	42°-43°			80°-81°				
	42	03	41.44	80	11	11.64	do	Do.
on light-house No. 2		09	11.90		04	40.20	do	Do.
t-house		09	17.49		04	46.95	do	Do.
dpipe of waterworks		07	53.30		05	50.80	do	Do.
rove		03	38.80		21	49.90	do	Do.
Isle light-house		09	56.70		06	56.70	do	Do.
	41°-42°			75°-76°				
ckawanna County	41	25	41.24	75	45	04.92	C. & G. S	Bull. 122.
Clinton County		37	48.30		25	37.60	G. S	Do.
e, church		24	03.54		41	14.23	C. & G. S	
		42	53.84		33	39.44	do	Do.
Tower		35	35.36		25	55.60	G. S	
mmit		08	53.00		50	30.80	do	Do.
ark, church		24	50 78		41	03 36	C. & G. S	
		32	29.01		34	28.58	G. S	Do.
		29	20.95		59	08.86	do	Do.
		27	20.65		29	44.07	C. & G. S	
ck, 1		05	04.29		56	27.47	G. S	Do.
		24	38.74		34	20.59	C. & G. S	
nt, church		28	22.88		36	23.74	do	
r		14	09.03		38	10.92	do	
ot		10	57.14		52	21.83	do	Do.
urg, church		24	38.04		38	30.25	do	
Hill		01	36.33		30	18.31	do	
tree		01	36.79		30	20.48	do	
nce, church		26	27.20		39	29.80	do	
		33	01.48		27	26.00	G. S	Do.
n, court-house		24	28.58		39	46.62	C. & G. S	
arre, church		14	31.77		53	03.59	do	
de, church		00	37.47		54	27.42	do	
ng		20	54.16		50	39.69	G. S	Do.
	41°-42°			76°-77°				
	41	57	31.92	76	36	58.96	S. S	Rept. '87.
		05	44.16		20	46.41	C. & G. S	Bull. 122.
		21	28.05		07	04.75	G. S	Do.
ld		59	22.88		25	48.22	S. S	Rept. '87.
ke, church		12	16.01		00	01.90	C. & G. S	Do.
eck, 2		02	13.91		05	03.40	G. S	Bull. 122.
		19	09.97		33	17.13	do	Do.
s		18	31.13		18	34.67	C. & G. S	Do.
inny		09	59.40		09	08.77	do	Do.
		59	23.38		10	43.82	S. S	Rept. '87.
	41°-42°			77°-78°				
	41	54	36.02	77	00	40.05	do	Do.
Head		58	15.90		43	41.40	C. & G. S	Do.
n		54	59.04		41	51.83	S. S	Do.

PENNSYLVANIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	41°-42°			80°-81°				
	°	′	″	°	′	″		
Edinboro	41	52	28.41	80	10	46.88	L. S.	Final Rep
State Line between Pennsylvania and Ohio.		59	17.70		29	08.20	do	Do.
	40°-41°			74°-75°				
Attleboro, academy cupola	40	10	53.56	74	55	17.83	do	
Belmont		08	22.41		56	48.39	do	
Briggs		12	25.09		53	37.11	do	
Bristol, Kenzey Hotel, cupola, called Posten's Hotel in 1877.		05	40.61		51	22.92	do	
Centerville		09	44.69		50	18.30	do	
China College		04	48.82		54	03.01	do	
Delanco		02	46.15		57	46.20	do	
Church spire		02	58.11		57	25.15	do	
Falsington		11	53.52		48	44.20	do	
Fisher		02	37.01		59	15.71	do	
Martingale		14	37.99		56	57.15	do	Bull. 122.
Newtown		15	03.41		55	13.93	do	
Oxford		10	24.34		53	41.71	do	
Partridge		03	16.62		58	33.33	do	
Pleasantville		09	51.19		59	04.35	do	
Stackhouse		09	59.18		55	01.55	do	
Thomas		13	14.82		58	19.69	do	
Turkey Hill		09	52.02		46	29.37	do	
Watson		12	14.66		55	28.20	do	
Wynkop		12	59.80		58	45.27	do	
	40°-41°			75°-76°				
Bethlehem, Reformed church	40	37	16.77	75	22	33.44	do	
Bake Oven		44	54.11		44	02.22	do	Do.
Big Rock		33	53.73		26	16.42	do	Do.
Black Spot		20	51.15		54	09.86	do	Do.
Tower		20	50.32		54	09.73	do	Do.
Bridesburg		00	02.75		03	42.51	do	
Arsenal flagstaff (1842)		00	29.24		03	59.66	do	
Foundry		00	13.16		03	46.87	do	
Church		00	08.61		03	58.95	do	
Arsenal flagstaff (1878)		00	29.06		04	00.71	do	
Cherry Tree		02	44.04		07	20.98	do	
Chestnut Hill, flagstaff		04	35.93		12	27.57	do	
Churchville		11	36.98		01	18.43	do	
Clapier		01	12.21		10	07.82	do	
Clark		00	15.43		14	17.40	do	
Collegeville, spire		02	44.22		01	01.96	do	
Diston:								
Flagstaff		01	07.15		02	14.71	do	
Chimney		01	05.93		02	23.04	do	
Dutch Settlement, Union church		03	49.00		04	43.00	S. S.	Rept. '83.
Fancy Hill, Berks County		19	24.89		42	52.13	C. & G. S.	Bull. 122.
Frankford:								
Pumping station		00	48.25		02	51.02	do	
Chimney		00	50.61		02	51.83	do	
Catholic church spire		00	42.48		05	25.03	do	
French		02	06.52		08	36.15	do	
George Knowles		01	17.67		01	53.53	do	
Germantown:								
Spire		01	02.16		10	48.10	do	
Church		01	55.66		10	29.23	do	
Haycock		29	18.96		13	10.34	do	
Knob		53	44.07		49	45.48	do	Do.
Kreutzer		37	15.58		31	42.05	do	Do.
Lennig:								
Square chimney		00	15.74		03	36.57	do	
Round chimney		00	21.34		03	40.29	do	
Lone Tree		48	10.50		52	43.52	do	
Long		21	28.35		42	03.79	do	Do.
Miles		11	16.96		03	13.18	do	
Pennypack		02	11.35		00	00.32	do	
Philadelphia:								
House of Correction		01	30.72		00	52.76	do	
Flagstaff		01	43.63		00	58.73	do	
Chimney		01	48.94		01	04.44	do	
St. Vincent's School cupola		01	21.10		01	53.09	do	
McKean's tower		01	11.80		10	07.75	do	
Potter's Mill, cupola		00	21.18		07	54.82	do	
Mr. George's house, flag-pole on cupola.		00	19.10		14	16.96	do	
Richard's house, cupola		00	42.13		10	46.87	do	
Port Clinton		36	15.05		59	27.82	do	Do.
Rockwell house		00	14.72		12	23.15	do	
Smith Gap		49	21.79		25	21.91	do	

PENNSYLVANIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41°	75°-76°		
	° ′ ″	° ′ ″		
pola on house	40 01 26.18	75 02 24.01	C. & G. S	
e	02 04.86	08 36.65	do	
ter line, Broad street, Phila-	02 04.81	08 45.58	do	
Hill:				
tower of school	49 35.58	52 27.34	do	
yterian church spire (sharp)	49 32.57	52 23.99	do	
lic church spire (blunt)	49 27.84	52 51.57	do	
ck, chimney	49 31.95	51 27.53	do	
r tower	01 42.92	02 41.24	do	
dist church spire	01 28.92	02 34.55	do	
Point	01 26.06	01 04.88	do	
	28 37.49	40 58.25	do	Bull. 122.
	00 33.06	03 21.12	do	
	09 10.67	03 01.80	do	
on	01 07.64	02 11.75	do	
ove	08 31.94	06 22.28	do	
	40°-41°	76°-77°		
	40 44 15.39	76 25 42.12	do	Do.
ad	51 01.35	04 47.65	do	Do.
	04 51.95	00 48.49	do	
	31 37.24	55 54.36	G. S	Do.
	35 42.95	37 03.20	do	Do.
	57 00.00	14 45.22	do	Do.
	56 20.28	25 33.10	do	Do.
	21 59.05	54 32.71	C. & G. S	Do.
e	46 09.67	15 28.06	G. S	Do.
Dick	14 46.77	27 21.11	C. & G. S	
, prison tower	02 24.58	17 33.52	do	
hanoy	44 35.47	49 56.57	G. S	Do.
	45 45.95	43 07.20	do	Do.
, 1	45 20.08	35 24.24	do	Do.
, 2	45 28.87	37 07.88	do	Do.
, 3	45 20.08	35 24.24	do	Do.
	56 29.82	49 00.42	C. & G. S	Do.
k, 3	59 08.98	18 46.16	G. S	Do.
p	06 13.24	55 34.14	C. & G. S	
Gap	28 15.40	32 23.52	do	
rse	30 55.19	17 33.95	do	Do.
orf	19 28.25	11 44.69	do	Do.
	52 45.62	34 33.03	G. S	Do.
	39°-40°	75°-76°		
	39 52 06.36	75 17 01.86	C. & G. S	
Reservoir	59 09.33	13 08.73	do	
	50 46.23	29 25.34	do	
	52 14.19	13 08.55	do	
	59 22.64	04 13.22	do	
se	54 48.45	25 26.01	do	
	55 00.77	13 36.05	do	
	56 43.51	08 19.31	do	
ll	53 22.52	13 29.37	do	
ley's flagstaff	50 51.75	21 35.07	do	
lic cathedral	51 05.43	21 39.13	do	
lic church	51 05.25	21 38.90	do	
all	50 52.20	21 36.86	do	
's Chemical Works chim-	50 37.28	21 26.76	do	
r's Seminary	51 21.58	22 16.78	do	
a Steel Works chimney	50 28.18	22 36.53	do	
's sugar refinery chimney	50 39.46	21 23.78	do	
& Leiper, cotton mill nney.	50 31.38	21 48.70	do	
n & Black—				
pola	51 03.29	21 06.36	do	
wmill chimney	51 03.74	21 05.19	do	
onal chimney	50 52.37	21 48.53	do	
yterian church	50 53.10	21 30.30	do	
—				
ouse	50 51.75	22 18.62	do	
ffice	50 26.68	22 04.66	do	
less Dyewood Works	50 12.00	22 19.34	do	
on, paint works, chimney	51 11.46	20 32.54	do	
ll, mill chimney	50 02.18	22 38.04	do	
, flagstaff	56 52.54	09 52.11	do	
	55 19.82	13 18.93	do	
eek, near mouth, engineer's	51 28.90	19 30.74	do	
	55 40.01	18 15.63	do	

PENNSYLVANIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Referer
	39°-40°			75°-76°				
	°	′	″	°	′	″		
Delaware Lead Works	39	56	36.71	75	08	13.46	C. & G. S	
Devine's mill (near Philadelphia) cupola.		56	48.73		10	37.36	do	
East League Island		53	14.88		09	58.07	do	
Eastwicks tower, vicinity of Philadelphia.		55	51.97		12	46.09	do	
Engineer signal, on wharf at Fort Mifflin.		52	28.13		12	40.99	do	
Factory, near Philadelphia		58	40.60		08	43.25	do	
Five Mile Point		59	04.44		04	29.83	do	
Five Mile Point, 2, Harrison Wharf		59	08.49		04	19.51	do	
Fort Mifflin:								
Flagstaff (1843)		52	31.64		12	45.33	do	
Light-house (1878-79)		52	14.49		12	27.05	do	
Fuller's tower		52	18.10		19	58 60	do	
General Jeffries, tower		52	43.57		19	25.23	do	
George Hill, elevator		59	02.92		13	29.03	do	
Gloucester Ferry		53	43.25		09	50.17	do	
Glue Chimney		58	55.50		05	57.97	do	
Gray's Ferry		56	27.22		12	28.70	do	
Hog Island		52	00.87		14	19.59	do	
Jenks		59	52.82		03	53.26	do	
Kensington:								
First Presbyterian church		58	12.69		07	48.40	do	
Iron works, black derrick		57	43.22		08	02.17	do	
Water pipe		58	09.66		07	24.65	do	
Lamoken		50	40.01		22	33.06	do	
Lazaretto		51	37.03		18	11.65	do	
Cupola		51	38.84		18	01.69	do	
Flagstaff (1849-1879)		51	25.97		18	02.14	do	
Lazaretto, 2		51	36.27		18	08.21	do	
League Island		53	09.09		11	28.62	do	
Leiperville (1843-1879)		52	25.62		19	34.94	do	
Lemon Hill		58	17.53		11	21.22	do	
Logan		54	03.10		08	05.58	do	
Londonderry		51	50.51		52	50.44	do	
Lukens		51	52.49		17	57.85	do	
Maddock		52	16.99		20	00.56	do	
Maiden Island, engineer signal 3		51	21.63		15	19.60	do	
Manderson, north chimney of house		57	54.14		07	06.26	do	
Marcus Hook		48	41.39		24	44.34	do	
Baptist church		48	49.14		24	47.78	do	
Episcopal church		48	52.65		24	41.65	do	
Pioneer Iron Works chimney		48	48.36		24	38.40	do	
Tenderthorpe Club House		48	38.71		24	59.52	do	
Missimer		44	59.07		48	03.78	do	
Monument Cemetery, spire		58	54.26		09	28.10	do	
Mount Hope		52	27.55		26	28.03	do	
Movies, 2 (1884)		59	23.70		02	36.51	do	
North League Island		53	14.84		09	57.83	do	
Old Bank		54	35.43		13	34.05	do	
Old Oak Tree		54	04.17		13	00.77	do	
One		54	43.87		08	10.90	do	
Paschall		54	49.36		14	30.05	do	
Pennsylvania Military Academy		51	42.04		21	20.40	do	
Penrose Ferry, lantern of draw		53	43.68		12	33.42	do	
Philadelphia:								
Aldine Hotel		57	06.48		10	22.58	do	
Almshouse, gray chimney		56	53.61		11	44.82	do	
Arch Street church		57	12.49		09	25.86	do	
Arch Street Hotel, corner		57	06.10		08	27.73	do	
Arch Street Wharf, house		57	05.30		08	23.86	do	
Baptist church		57	16.01		11	40.77	do	
Baugh's black derrick		55	28.26		08	20.63	do	
Beck's shot tower		57	23.39		10	31.61	do	
Boiler house chimney		54	50.63		08	05.08	do	
Boston Steamship Co. (pier 20 S. W.).		56	34.81		08	30.77	do	
Brown street, river market house		57	41.25		08	13.37	do	
Burd's Orphan Asylum, cross on lower cupola.		57	43.59		15	05.08	do	
Burnt Factory, south chimney (old lazaretto).		53	19.79		12	23.61	do	
Center line of Broad street on tower of city hall.		57	10.08		09	49.86	do	
Central High School Observatory		57	47.20		09	40.81	do	
City hall—								
Center line of Broad street		57	06.85		09	50.53	do	
Main tower station (near northwest corner).		57	10.05		09	50.17	do	
Christ church		57	02.67		08	39.73	do	

PENNSYLVANIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	39°-40°	75°-76°		
Philadelphia—Continued.	° ′ ″	° ′ ″		
Cramp's shears	39 58 13.52	75 07 02.39	C. & G. S.	
Delaware avenue market house	56 39.78	08 34.15	do	
Fire plug, Fifty-third street	57 36.48	13 37.52	do	
Franklin Sugar Refinery, south turret.	56 22.32	08 34.24	do	
Gas tower (west tower near river)	55 16.90	12 09.32	do	
Girard College, on roof of	58 26.60	10 13.54	do	
Girard Point elevator	53 40.32	11 54.31	do	
Jaynes tower	56 54.55	08 45.48	do	
Levee, 1	53 54.41	08 27.87	do	
Levee, 2	53 41.23	09 06.73	do	
Lombard street wharf	56 29.01	08 30.48	do	
Market street, northeast corner of wharf.	56 56.56	08 26.39	do	
Market street and Delaware avenue.	56 59.02	08 29.70	do	
Moro Philips flagstaff (pier 35 S. W.).	56 16.70	08 29.92	do	
Navy-yard flagstaff	53 16.26	10 30.46	do	
Navy-yard signal, center of Broad street.	53 29.78	10 37.76	do	
Neafie and Levy's shears	57 59.55	07 35.76	do	
New high school	57 47.19	09 40.81	do	
Noble street wharf	57 30.70	08 12.26	do	
Old high school, observatory	57 05.95	09 45.20	do	
Old navy-yard shears	55 52.00	08 29.41	do	
Otis street, north corner of wharf.	58 05.41	07 20.93	do	
Park elevator	58 17.54	11 21.31	do	
Philadelphia and Reading (pier 14 S. W.).	56 42.44	08 29.56	do	
Philadelphia and Reading R. R. wharf.	58 21.83	06 41.75	do	
Post-office	57 02.19	09 21.48	do	
Presbyterian Home	55 59.82	13 37.91	do	
Race Street Wharf	57 19.97	08 21.68	do	
Ridgeway House—				
Corner	56 59.01	08 29.71	do	
Flagstaff	56 59.25	08 29.76	do	
Roman Catholic cathedral	57 26.71	10 07.66	do	
St. Bonificius church	58 54.60	08 08.48	do	
St. John's church spire	58 11.87	09 43.14	do	
St. Paul's church	57 47.59	08 31.12	do	
St. Philip's Literary Institute, octagonal spire on Queen street, near Sixth.	56 16.35	09 12.04	do	
St. Peter's church	56 35.34	08 53.38	do	
Salt works chimney	54 47.95	08 19.75	do	
Salt company's wharf	54 51.85	07 59.35	do	
Screw dock	57 49.99	07 56.06	do	
Shackamaxon street (pier 49, wharfage signpost).	57 50.12	07 51.18	do	
Ship house, south gable	53 14.68	10 38.81	do	
Sparks shot tower	56 05.23	08 48.00	do	
State House, cupola	56 55.64	09 09.41	do	
University of Pennsylvania, east tower.	57 05.11	11 37.23	do	
Vine street ferry flagstaff	57 18.99	08 22.74	do	
West Arch Street church	57 17.57	10 10.93	do	
West Philadelphia Hall, flagstaff	57 22.25	11 46.61	do	
Pike	59 05.80	04 45.48	do	
Point Breeze	54 31.71	12 18.56	do	
Flagstaff	54 11.11	11 42.30	do	
Richmond	58 18.71	06 59.44	do	
Ridley Creek	51 11.90	20 24.61	do	
Sanderson	50 12.92	23 50.97	do	
Schuylkill	53 35.90	11 42.32	do	
Schuylkill Range beacon, front (1878).	53 20.11	11 38.25	do	
Schuylkill Range beacon, rear (1878-79).	53 27.22	11 34.95	do	
Schuylkill arsenal, flagstaff on cupola.	56 26.33	11 20.16	do	
Scott	55 59.19	08 27.31	do	
Serrill	52 58.19	14 49.91	do	
Sinickson	54 29.07	07 56.97	do	
Smith Island	56 21.05	08 15.82	do	
Flagstaff	56 48.66	08 17.27	do	
Smith Island, 2	56 47.97	08 09.75	do	
South Chester, schoolhouse	50 39.06	23 05.62	do	
South League Island, 2	53 09.13	11 28.68	do	
South League Island, Die River	53 09.12	11 28.66	do	
Stewart	52 25.01	19 34.57	do	
Strickersville	43 55.38	47 27.54	do	

PENNSYLVANIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	39°-40° ° ′ ″	75°-76° ° ′ ″		
Three	39 53 47.69	75 08 47.38	C. & G. S	
Thurlow	49 41.25	23 11.90	do	
Tinnicum	51 42.32	16 03.89	do	
Tioga, 2 (1884)	58 45.36	05 14.26	do	
Tonkins Island west	48 52.09	22 50.64	do	
Trainer's (E.) mill, 3	49 37.65	24 08.06	do	
Trainer's (E.) tower	49 54.54	24 34.19	do	
West Philadelphia, Presbyterian hospital.	57 30.81	11 58.50	do	
Windmill Island, 1	56 34.37	08 18.95	do	
Windmill Island, 2	56 25.88	08 14.40	do	
Windmill Island:				
South point post	56 18.84	08 15.10	do	
Chimney	56 34.34	08 14.22	do	
Yard	58 24.80	23 13.79	do	
	39°-40°	76°-77°		
Pulpit Rock	39 51 28.77	76 56 53.27	do	
Rawlinsville	53 09.54	15 58.37	do	
Winterstown	49 32.07	36 09.30	do	

DELAWARE.

	39°-40° ° ′ ″	75°-76° ° ′ ″		
Buck, 2	39 32 28.78	75 43 55.18	C. & G. S	
Grandview	42 42.66	42 22.72	do	
Iron Hill	38 20.48	45 07.67	do	
Meetinghouse Hill	42 46.28	42 40.12	do	
Naaman Creek	48 05.47	26 32.96	do	
Naaman Creek, 2	48 17.61	26 01.06	do	
Taggart	47 29.91	27 37.10	do	

MARYLAND.

	39°-40° ° ′ ″	75°-76° ° ′ ″		
Gray Hill	39 36 47.69	75 47 51.69	C. & G. S	
	39°-40°	76°-77°		
Abingdon, cupola	39 27 41.50	76 16 42.21	do	
Baltimore Cemetery, brown spire	18 45.23	34 52.00	do	
Baltimore:				
City Hall cupola	17 27.12	36 39.68	do	
Fort Avenue—				
East base	15 56.51	35 05.60	do	
West base	16 19.53	36 11.32	do	
Grace church spire, Methodist	17 52.00	38 14.42	do	
Hospital (1863)	17 50.35	35 31.39	do	
Holy Cross, German Catholic church spire.	16 34.28	36 41.33	do	
Johns Hopkins, hospital cupola	17 50.25	36 36.91	do	
Sacred Heart Catholic church spire.	17 04.89	34 08.38	do	
St. James church spire	18 04.54	36 07.59	do	
St. John's church, brown spire	19 31.52	36 33.24	do	
Washington Monument, head of statue.	17 51.07	36 57.34	do	
Bay View Asylum, vane	17 23.33	33 06.73	do	
Buchanan	15 29.85	32 39.66	do	
Canton, cupola Chipman's chair factory.	16 45.92	34 44.71	do	
Chase, flagstaff on B. & O. coffee warehouse on Chase's wharf.	16 44.89	35 47.12	do	
Clifton, cupola vane	19 14.99	35 15.05	do	
Clinton	15 44.52	34 06.91	do	
Colgate	15 25.23	32 30.74	do	
De Sales, cross on cupola Mt. De Sales Carmelite convent.	17 06.57	43 19.86	do	
Druid, small spire on cupola of Druid Hill Park House.	19 24.48	38 50.44	do	
Elevator B, belfry	16 11.02	35 02.05	do	
Federal (1886)	16 48.96	36 30.17	do	
Ferry	15 33.04	36 44.83	do	
Finlay, on Cubb Hill	24 28.00	31 28.51	do	
Fishing Point	13 50.75	33 49.13	do	

MARYLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
		39°-40°			76°-77°			
	°	′	″	°	′	″		
harf	39	15	43.87	76	34	20.55	C. & G. S.	
enue:								
base		15	56.52		35	05.60	do	
t base		16	19.53		36	11.32	do	
roll light-house (1866)		12	52.95		31	09.04	do	
rshall, flagstaff (1863)		17	07.46		34	06.02	do	
Henry, most easterly salient		15	47.38		34	45.86	do	
Henry (1842-1886)		15	47.47		34	46.88	do	
Ax, vane of tobacco factory		16	59.36		36	51.22	do	
		15	01.07		31	36.44	do	
		16	32.86		34	11.99	do	
upola, west end B. & O. piers).		16	21.53		35	16.00	do	
Iount Cemetery, brown spire		18	25.93		36	27.82	do	
actory cupola, a mill in 1866		16	43.66		36	32.94	do	
s Point light-house (1869)		12	28.42		31	58.38	do	
s Point, 2 (1866)		12	35.24		31	59.89	do	
s Point, 3 (1866)		12	34.89		31	57.96	do	
Refuge, apex of taller turret		15	51.12		43	25.70	do	
iano factory, cupola vane		16	38.69		37	21.17	do	
		13	00.74		33	00.43	do	
Point light-house (1869)		12	49.33		33	07.80	do	
ce		16	19.41		36	06.71	do	
to Point light-house (1843-		15	45.66		34	17.96	do	
		05	21.73		29	08.80	do	
in water area		15	09.28		26	52.34	do	
ld, house cupola		20	19.09		36	47.34	do	
		15	52.96		37	13.30	do	
Alto		19	06.20		40	33.61	do	
		14	46.75		36	07.32	do	
ame Convent, lightning rod		21	05.13		37	17.50	do	
		16	18.99		40	21.11	do	
River		27	54.94		16	52.84	do	
ill		20	15.02		33	40.71	do	
o		35	36.69		00	16.41	do	
oint, 2 (1866)		10	02.02		28	43.01	do	
e		17	30.76		43	04.56	do	
Point, 2 (1866)		13	39.96		30	49.19	do	
Point, 3 (1866)		13	39.37		30	48.26	do	
Shore		13	54.22		31	02.42	do	
ill		14	51.35		35	01.61	do	
's Wharf, flagstaff		16	42.12		35	50.02	do	
hite spire		16	18.14		39	27.86	do	
		05	11.84		57	00.72	do	
Gardens		16	24.49		37	38.20	do	
		07	17.71		59	06.49	do	
		16	48.54		35	58.11	do	
		14	31.75		34	01.80	do	
States bonded warehouse, aff.		16	47.45		35	23.69	do	
		05	26.05		40	32.16	do	
l		16	15.22		35	53.25	do	
wn House, apex of roof		19	38.43		37	53.71	do	
		39°-40°			77°-78°			
Hill	39	04	32.46	77	18	38.80	do	
n, near Frederick		20	43.89		31	12.35	do	
w		39	18.10		58	10.90	do	
ck:								
wn spire, dark top		24	55.07		24	46.04	do	
heran church—								
East spire		24	55.27		24	34.10	do	
West spire		24	55.33		24	34.78	do	
holic church spire		24	56.97		24	28.05	do	
nob, near Frederick		27	42.24		29	44.20	do	
one Ridge		10	52.64		26	29.75	do	
J. N.), red barn, south gable		11	38.43		26	16.60	do	
nd Heights, near Frederick		20	27.69		42	59.91	do	Bull. 122
house, stone		00	25.98		11	14.80	do	
Hill		10	24.14		28	58.22	do	
ille		08	16.22		25	11.64	do	
n hall, flagstaff on south gable		08	38.91		25	00.75	do	
le, white spire		04	54.41		08	43.03	do	
Hill		13	37.17		25	03.57	do	
v Point, 2 (1866)		12	41.32		29	26.26	do	
af		15	44.54		23	36.88	do	Do.
house with wooden wing, east chimney.		12	17.00		27	14.50	do	
		39°-40°			78°-79°			
Creek Mountain	39	37	12.00	78	07	03.30	do	

MARYLAND—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			79°-80°				
	°	′	″	°	′	″		
Fairfax Stone	39	43	18.00	79	28	56.60	C. & G. S.	
	38°-39°			76°-77°				
Addison	38	49	30.91	76	58	44.43	do	
Annapolis		58	53.50		29	00.00	do	
Bladensburg church, east apex		56	26.09		56	27.31	do	
Brick house, cupola		58	42.67		57	33.84	do	
Hatton		42	58.51		59	15.01	do	
Hill		53	54.91		52	49.76	do	
Magruder		54	36.56		55	45.23	do	
Maryland Agricultural College		59	00.88		56	37.88	do	
Marriott		52	26.98		36	37.11	do	
Painted house, south apex		56	15.70		56	05.40	do	
Reform school		55	31.25		57	34.37	do	
Riggs, lightning rod on barn cupola		58	12.96		58	27.55	do	
Snyder, house gable		57	43.81		57	21.73	do	
Stearer, lightning rod on east chimney.		52	27.38		55	35.09	do	
Wright		54	12.13		54	34.04	do	
Yellow mill, south apex		56	31.27		56	06.12	do	
Yellow roof, white cupola		56	46.74		56	33.35	do	
Yoe (Wm.), chimney		50	17.21		57	53.52	do	
	38°-39°			77°-78°				
Blair's flagstaff	38	59	29.55	77	01	57.16	do	
Briscoe, Potomac River		40	54.56		06	21.55	do	
Bryant Point, Potomac River		41	44.06		04	06.93	do	
Carroll, lightning rod		58	43.99		00	15.58	do	
Countsman, house chimney		57	55.55		04	58.65	do	
Ferry Point		48	20.55		01	18.39	do	
Potomac River		41	49.85		06	18.33	do	
Fort Washington:								
Signal		42	45.43		02	11.14	do	
Flagstaff		42	40.34		02	06.22	do	
Glymont pavilion, Potomac River		36	36.59		08	23.75	do	
Gut Landing, Potomac river		39	50.74		06	57.60	do	
Indian Head, Potomac River		35	57.41		11	02.20	do	
Marshall Point, Potomac River		41	09.49		06	01.28	do	
Mockley Point, Potomac River		42	07.52		02	45.41	do	
North Indian Head, Potomac River		36	24.02		10	12.79	do	
Oxon Hill		47	58.52		00	23.69	do	
Pamunkey Creek		38	04.12		06	39.74	do	
Port Tobacco court-house, cupola		30	40.77		01	14.18	do	
Pye's Wharf, Potomac River		36	41.87		08	15.33	do	
Rosier Bluff, Potomac River		46	20.32		01	51.15	do	
Rozier (C.), west gable of house		46	31.47		01	08.63	do	
Simmons		57	07.74		05	53.41	do	
Stevenson, Potomac River		40	16.03		06	54.05	do	
Stump Neck, Potomac River		33	15.66		13	29.60	do	
Sumner		57	18.77		07	30.77	do	
White Stone Point, Potomac River		40	34.37		07	48.85	do	

DISTRICT OF COLUMBIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			76°-77°				
	°	′	″	°	′	″		
Fort Dupont, flagstaff	38	52	22.40	76	56	26.10	C. & G. S	
	38°-39°			77°-78°				
Apex Washington Monument	38	53	22.02	77	02	07.78	do	
Capitol, head of statue		53	23.25		00	33.55	do	
Causten		55	35.29		04	23.81	do	
Georgetown College, observatory		54	29.94		04	39.05	do	
Insane Asylum		51	17.18		00	00.92	do	
Kengley's house, lightning rod on southeast chimney.		55	34.56		04	26.12	do	
Soldiers' Home		56	29.85		00	40.48	do	
Wayland Seminary		55	17.33		02	08.53	do	
Naval Observatory, pole on dome		53	42.25		03	06.10	do	
Station east of dome		53	42.31		03	05.81	do	

VIRGINIA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			77°-78°				
	°	′	″	°	′	″		
Distant lone tree	39	04	49.60	77	39	00.20	C. & G. S	
Leesburg		07	45.62		35	06.16	do	
Maryland Heights		20	27.69		42	59.91	do	Bull. 122.
Maryland Heights (S.)		20	09.97		43	09.14	do	

VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			77°-78°				
	°	′	″	°	′	″		
Old Pine Tree Hill	39	11	31.23	77	34	20.62	C. & G. S	
Whitehouse, chimney on northeast gable.		11	08.90		33	19.10	do	
	39°-40°			78°-79°				
Capon Mountain	39	08	33.30	78	26	06.40	do	Bull. 122.
Lockhart		14	12.60		19	17.00	do	
Locks		26	27.20		11	33.40	do	
Rock Enon		10	39.30		23	23.90	do	
Shockey		23	25.80		13	47.50	do	
Alexandria:	38°-39°			77°-78°				
Baptist church	38	48	23.25	77	02	40.58	do	
Christ church		48	22.64		02	52.37	do	
High School		49	27.91		05	40.05	do	
Northern coal wharf		48	51.11		02	11.94	do	
Hotel tower		48	19.10		02	32.65	do	
Theological Seminary, near, new spire cross.		49	13.53		05	31.33	do	
Market House cupola		48	19.57		02	36.74	do	
Pioneer Mills chimney		48	05.96		02	24.75	do	
Machine shop, brown cupola		48	37.15		02	44.84	do	
St. Mary's church		48	06.70		02	39.27	do	
Arlington, flagstaff in front of mansion house.		52	52.10		04	21.10	do	
Arlington House, east apex		52	52.15		04	21.89	do	
Big Cobbler Mountain		50	21.00		57	11.00	do	
Bull Run		52	53.58		42	12.61	do	Do.
Cockpit Point, Potomac River		33	22.77		15	46.45	do	
Culpeper Court-house, flag		28	25.58		59	51.27	do	
Dangerfield		49	45.05		02	19.44	do	
Ellsworth		48	30.02		04	09.94	do	
Erin		46	48.60		05	54.50	do	
Falls Church		52	52.39		10	13.15	do	
Fredericksburg, Episcopal church spire.		18	09.57		27	35.33	do	
Fort Myer, flagstaff		53	07.75		04	39.60	do	
Fowle, house cupola		47	47.26		05	48.54	do	
Gillingham, house chimney		46	37.44		04	56.81	do	
Gravelly		52	00.93		02	12.47	do	
Gunston Cove, Potomac River		39	20.07		08	39.11	do	
Hallowing Point, Potomac River		38	05.56		07	51.72	do	
Hall, house cupola		54	19.89		07	44.82	do	
Hamersley		45	28.66		04	09.49	do	
Hospital, cupola		52	03.81		04	07.52	do	
Hell Hole Point, Potomac River		46	00.70		02	29.01	do	
Hunter		50	45.37		02	23.21	do	
Hunting Creek Bridge, flag		47	33.46		03	24.92	do	
Johnson, house chimney		47	21.77		04	18.76	do	
Jones Point light-house (1863)		47	25.34		02	27.12	do	
Langley church, south gable		56	51.05		09	37.83	do	
Lewinsville church, south gable		55	46.73		11	50.65	do	
Lyon		47	26.43		04	37.79	do	
Marcy		56	06.15		07	35.62	do	
Miner Hill		54	23.89		09	33.61	do	
Mount Vernon wharf signboard, Potomac River.		42	19.47		05	19.89	do	
Munson Hill, flag		51	36.30		08	44.10	do	
Occoquan		38	14.30		12	59.75	do	
Peach Grove		55	12.74		13	46.77	do	
Port Royal		10	24.09		11	24.63	do	
Rocker (A.), chimney on house		46	43.28		05	55.65	do	
Shipping Point, Potomac River		31	38.44		17	00.07	do	
Strong		53	49.24		05	20.10	do	
Square yellow house, cupola		49	09.03		04	41.26	do	
Telegraph pole		52	39.51		02	10.07	do	
Upton Hill		52	19.50		08	49.99	do	
View Tree, near Warrenton		44	01.97		50	09.98	do	
Watery Mountain		47	32.00		50	23.00	do	
White house, cupola		51	32.32		04	00.76	do	
Worth		48	52.90		05	55.56	do	
	38°-39°			78°-79°				
Bluff Mountain	38	26	26.00	78	25	00.00	do	
Clark		18	41.11		00	11.49	do	Do.
Forks		28	44.81		24	57.47	do	Do.
Hawksbill		33	19.00		23	44.00	do	
High Knob, probably Fire Mountain, south side of Manassas Gap, Blue Ridge.		53	12.13		06	43.84	do	Do.
Jannau		06	18.53		44	38.69	do	
Keller		55	08.99		23	31.30	do	

VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	38°-39°			78°-79°				
	°	′	″	°	′	″		
Marshall	38	46	33.82	78	12	10.28	C. & G. S	Bull. 122.
Mary Rock		38	53.00		19	26.00	do	
McCormick Observatory, pier		01	58.06		31	20.62	do	
Peaked		23	33.97		46	12.63	do	
Peters Mountain		07	32.80		17	10.71	do	
Ragged Rock		32	06.00		18	54.00	do	
Rattlesnake		51	53.00		02	36.00	do	
Saddle Mountain		20	09.00		33	07.00	do	
Stonyman Mountain		35	52.00		22	20.00	do	
Strasburg		59	31.40		21	33.70	do	
Astronomical station		59	29.96		21	39.01	do	
Lutheran church		59	26.80		21	44.70	do	
Presbyterian church		59	12.21		21	46.37	do	
Thoroughfare Mountain, summit		24	52.00		09	25.00	do	
Turks Mountain		18	16.00		38	45.00	do	
University of Virginia, dome		02	08.31		30	13.01	do	
	38°-39°			79°-80°				
Elliott Knob	38	09	59.36	79	18	51.30	do	Do.
Flag Rock		02	33.00		46	23.00	do	
North		51	28.90		48	20.20	G. S	Do.
North River Mountain		23	39.00		15	29.00	C. & G. S	
Northeast Peak		09	45.00		31	19.00	do	
Shenandoah, Jack Mountain		24	22.00		30	48.00	do	
Sounding Knob, lone tree		20	47.00		35	25.00	do	
Staunton, astronomical station		08	46.54		04	19.08	do	
	37°-38°			76°-77°				
Fortress Monroe, flagstaff	37	00	05.93	76	18	32.10	do	
Tappahannock, Episcopal church spire.		55	39.38		51	31.35	do	
Yorktown		16	09.64		30	28.38	do	
Petersburg:	37°-38°			77°-78°				
Court-house	37	13	50.74	77	24	13.56	do	
Catholic church		13	38.65		24	24.29	do	
Presbyterian church		13	49.03		24	19.41	do	
Methodist church		13	39.77		24	09.73	do	
Richmond:								
Baptist College tower		33	08.94		27	21.32	do	
Capitol, flag pole on east end of building.		32	16.38		26	04.04	do	
Capitol, flagstaff on center of building.		32	19.50		26	01.66	do	
St. Paul's church		32	23.48		26	06.82	do	
Roslyn:								
Astronomical station		14	28.33		23	50.71	do	
Petersburg transit		14	25.48		23	45.14	do	
	37°-38°			78°-79°				
Baker	37	12	09.57	78	38	39.19	G. S	Do.
Humpback		56	55.91		53	57.24	C. & G. S	Do.
Leigh		12	14.21		21	32.82	G. S	Do.
Mountain southwest of Humpback		54	58.00		57	16.00	C. & G. S	
Pilot Mountain, summit		19	30.00		58	05.00	do	
Spear		33	42.91		45	46.66	do	Do.
Sugarloaf, summit		46	57.00		49	16.00	do	
Three Ridge, summit		51	29.00		59	02.00	do	
Willis		28	22.68		27	52.90	do	
	37°-38°			79°-80°				
Amherst court-house cupola	37	35	06.30	79	03	04.30	do	
Apple Orchard, summit		31	03.00		30	41.00	do	
Bald Friar, summit		49	12.00		03	42.00	do	
Bald Knob		55	32.64		51	04.72	do	
Bald Knob, No. 1		51	00.00		55	35.00	do	
Big Level Mountain, lone tree		56	34.00		06	47.00	do	
Brushy		00	37.16		19	41.32	G. S	Do.
Campbell court-house, jail		16	33.30		06	11.60	C. & G. S	
Chandler Mountain, summit		20	12.00		08	12.00	do	
Cole Mountain		45	06.00		12	19.00	do	
Covington, transit		47	17.00		59	38.40	do	
Dry Mountain		06	22.90		03	47.99	G. S	Do.
First peak northeast of Flat Top, summit.		28	47.00		32	44.00	C. & G. S	
Flat Top		27	06.85		34	58.40	do	Do.
Johnson		11	32.78		21	42.56	G. S	Do.
Johnson Mountain, summit		11	51.00		21	06.00	C. & G. S	Do.
Long		17	27.65		05	10.24	do	
Lynchburg court-house, belfry		24	49.10		08	40.52	do	
Mount Pleasant, summit		44	27.00		10	17.00	do	
Mountain northwest of Mount Pleasant.		44	24.00		13	25.00	do	

VIRGINIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	37°-38°	79°-80°		
	° ′ ″	° ′ ″		
No Business Mountain, summit	37 28 13.00	79 22 35.00	C. & G. S	
Northeast House Mountain	49 45.00	32 36.00	do	
Rocky Mountain	46 01.00	11 16.00	do	
Round Top, near James River	28 08.00	00 27.00	do	
Second peak northeast of Flat Top	29 46.00	30 55.00	do	
Southwest House Mountain	49 51.00	33 43.00	do	
Southwest peak of Otter, summit	26 00.00	36 18.00	do	
Smith	00 51.53	33 56.93	do	Bull. 122.
Tobacco Row	33 55.76	11 26.17	do	Do.
Tyrecana church	23 27.70	06 18.30	do	
Weavers Knob summit	18 14.00	49 25.00	do	
	37°-38°	80°-81°		
Buckhorn	37 17 33.55	80 58 49.30	G. S	Do.
Cahas	07 01.95	00 56.64	do	Do.
Peak	01 22.00	44 54.50	do	Do.
Potts	36 02.90	08 45.00	do	Do.
Salt Pond	21 00.80	32 15.30	do	Do.
Streets	09 46.10	11 33.90	do	Do.
	37°-38°	81°-82°		
Bear Wallow	37 14 38.60	81 44 50.20	do	Do.
Big Bend	01 37.80	10 56.40	do	Do.
Dial Rock	09 58.40	25 00.30	do	Do.
Morris	02 57.50	37 01.60	do	Do.
	37°-38°	82°-83°		
Big Butt	37 03 09.20	82 02 08.00	do	Do.
	36°-37°	76°-77°		
Newport News	36 58 00.81	76 25 21.52	do	
Norfolk:				
Baptist church spire	51 01.31	17 13.75	do	
City hall	50 50.59	17 19.95	do	
	36°-37°	79°-80°		
Chestnut Mountain, summit	36 50 54.00	79 50 46.00	do	
Turkey	50 11.19	39 28.25	do	Do.
White Oak	42 51.80	25 34.90	do	Do.
	36°-37°	80°-81°		
Buffalo	36 47 46.25	80 28 39.04	C. & G. S	Do.
Bull Mountain	41 34.97	13 29.93	do	
Draper	57 56.70	53 53.50	G. S	Do.
Rich	34 37.60	49 31.90	do	Do.
	36°-37°	81°-82°		
Lookout	36 40 04.50	81 10 03.20	do	Do.
Red Rock	55 20.00	48 22.00	do	Do.
Ripshin	50 28.30	21 37.80	do	Do.
Rogers	39 36.10	32 42.00	do	Do.
White Top	38 21.76	36 12.48	do	Do.
	36°-37°	82°-83°		
Clinch	36 49 44.50	82 04 46.00	do	Do.
Goodson	35 49.10	11 13.10	C. & G. S	
High Knob	53 33.00	37 46.10	G. S	Do.

WEST VIRGINIA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41°	80°-81°		
	° ′ ″	° ′ ″		
Wheeling	40 04 04.00	80 43 36.60	C. & G. S	Rept. '84.
	39°-40°	78°-79°		
Capon	39 08 36.40	78 26 03.70	do	Bull. 122.
Locks	26 27.20	11 33.40	do	
Paddy	00 24.40	33 47.70	G. S	Do.
Sleepy Creek Mountain	37 12.00	07 03.00	C. & G. S	
	39°-40°	79°-80°		
Felton	39 23 21.70	79 39 07.10	G. S	Do.
Laurel	09 34.70	49 42.50	do	Do.
Nelson	27 53.30	56 06.20	do	Do.
	39°-40°	80°-81°		
Bear Knob	39 03 25.10	80 17 23.70	do	Do.
Cameron	49 46.00	34 22.50	C. & G. S	Rept. '84.
Clarksburg	16 56.00	20 22.05	do	Do.
Grafton		01 40.80	do	Do.
Little Bald	20 09.10	14 22.70	G. S	Bull. 122.
Sinking Creek	01 17.60	51 56.80	do	Do.
Sugar Loaf	02 02.75	33 49.70	do	Do.

WEST VIRGINIA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	38°-39°			79°-80°				
	°	′	″	°	′	″		
Bickles	38	56	03.40	79	43	54.40	G. S	Bull. 122.
Briery Branch Mountain		27	45.30		14	31.30	C. & G. S	Do.
Green		53	50.70		26	36.70	G. S	Do.
North		51	28.90		48	20.20	do	Do.
Paddy		15	56.77		47	46.29	do	Do.
Panther Knob		34	07.00		10	14.90	C. & G. S	Do.
Panther		33	48.30		29	45.30	G. S	Do.
Rich		50	01.85		56	22.60	do	Do.
Slate Springs		30	35.71		11	03.66	do	
Spruce		41	58 70		31	59.50	do	Do.
	38°-39°			80°-81°				
Big Run	38	47	41.90	80	15	30.15	do	Do.
Beech		06	44.63		36	18.88	do	Do.
Briery		08	39.65		20	40.40	do	Do.
Cedar Creek		54	30.30		53	52.70	do	Do.
Cold Knob		03	43.00		28	30.00	C. & G. S	
Grassy Knob		03	20.00		30	14.00	do	
High Knob		15	46.10		12	20.80	do	
Locust		53	28.15		41	06.65	G. S	Do.
Job Knob		04	46.70		32	32.65	C. & G. S	
Nicholas court-house belfry		16	50.50		52	02.50	do	
Powell Mountain		18	10.00		48	37.00	do	
Rush		55	25.00		32	42.60	G. S	Do.
Summersville		16	55.42		52	07.65	C. & G. S	Do.
	38°-39°			81°-82°				
Big Rocks	38	30	51.23	81	55	29.23	do	
Charleston		21	07.20		38	00.00	do	Rept. '84.
Creed		24	16.82		33	35.50	do	
Elk		22	20.73		36	56.57	G. S	
Ferguson		20	37.96		38	14.93	C. & G. S	
Fort Scammon		21	06.32		39	16.94	G. S	
Gauley Bridge		09	08.70		12	57.00	C. & G. S	
Gauley Mountains		10	50.00		04	27.00	do	
Do		10	53.00		04	19.00	do	Bull. 122.
Holmes		25	40.87		35	34.31	do	Do.
Martin		21	25.36		36	18.14	do	
Table Rock		11	18.56		36	53.13	do	Do.
	38°-39°			82°-83°				
Davis	38	21	06.31	82	21	12.15	do	
Gebhardt		31	45.73		15	10.88	do	
Oakland		21	46.57		38	52.68	do	
Pigeon		13	44.13		03	59.86	do	
Piney		26	39.66		06	28.84	do	
Point Pleasant		50	28.00		08	45.30	do	Rept. '84.
	37°-38°			80°-81°				
Big Clear Creek Mountain	37	57	52.00	80	36	05.00	do	Do.
Big Sewall Mountain		54	35.40		55	42.36	do	Do.
Keeney		46	24.91		42	19.05	do	Do.
	37°-38°			81°-82°				
Burning Rock	37	41	38.00	81	41	51.60	G. S	Bull. 122.
Ivy		47	15.78		29	28.28	C. & G. S	
Long Flat Mountain		53	18.00		25	46.00	do	
Do		53	16.00		26	00.00	do	
Paint Creek		56	50.79		18	28.82	do	Do.
Pilot		29	04.30		16	18.80	G. S	Do.
Sharp Peak		53	56.00		19	52.00	C. & G. S	
Townsend Mountain		56	30.00		17	43.00	do	

NORTH CAROLINA.

	36°-37°			80°-81°				
	°	′	″	°	′	″		
Lauratown	36	22	33.00	80	22	17.00	C. & G. S	
Moore		23	53.60		16	59.24	do	
Pilot Knob		20	24.53		28	28.19	do	
Warrior Mountain		29	13.00		51	45.00	do	
	36°-37°			81°-82°				
Bullhead	36	26	49.70	81	04	00.70	do	Bull. 122.
Elk Knob		20	40.00		42	31.00	do	
Flat Top Mountain, Blue Ridge		09	44.00		40	37.00	do	
Grandfather		06	41.50		48	36.90	do	Do.
Negro		24	11.60		27	48.70	do	Do.
Poore		02	47.66		09	24.24	do	Do.
Snake		19	51.10		42	28.20	do	Do.

NORTH CAROLINA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	35°-36°	80°-81°		
	° ′ ″	° ′ ″		
Statesville astronomical station	35 46 56.55	80 53 39.94	C. & G. S	
Statesville, Simonton College	46 57.94	53 39.05	do	
Young	44 14.49	38 51.16	do	Bull. 122.
	35°-36°	81°-82°		
Anderson	35 33 57.32	81 05 26.80	do	
Benn	33 55.06	39 37.55	do	Do.
Hibriton	54 25.40	29 22.70	G. S	Do.
King	12 27.87	18 45.59	C. & G. S	Do.
Lincolnton court-house cupola	28 16.87	15 25.67	do	
Table Rock	53 27.70	52 59.00	G. S	Do.
Thicketty	06 48.24	46 08.21	C. & G. S	
	35°-36°	82°-83°		
Balsam	35 22 02.10	82 59 24.70	G S	Do.
Big Bald	59 23.50	29 25.00	do	Do.
Mitchell	45 53.60	15 54.50	do	Do.
Pisgah	25 32.50	45 24.60	do	Do.
Sandymush	40 41.70	53 01.40	do	Do.
	35°-36°	83°-84°		
Cheowah	35 19 32.20	83 40 30.70	do	Do.
Christie Peak	23 09.40	58 10.10	do	Do.
Cowee	19 39.90	20 10.00	do	Do.
Thomas Bald	02 07.30	32 16.80	do	Do.
Thunderhead	34 06.80	42 22.50	do	Do.
Tusquittah	08 42.50	43 35.20	do	Do.
	35°-36°	84°-85°		
Haw Knob	35 18 34.20	84 01 35.20	do	Do.
Pack	03 00.90	17 10.00	do	Do.

SOUTH CAROLINA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	35°-36°	82°-83°		
	° ′ ″	° ′ ″		
Hogback	35 10 12.25	82 17 26.34	C. & G. S	Bull. 122.
Pinnacle	02 00.85	44 30.02	do	Do.
	34°-35°	81°-82°		
Wofford	34 57 32.31	81 56 06.73	do	Do.
Greenville:	34°-35°	82°-83°		
Baptist spire	34 50 59.78	82 24 05.08	do	
Episcopal spire cross	51 02.58	23 40.79	do	
Furman University turret	50 29.15	24 11.34	do	
White tower, conical dark roof	50 55.36	23 44.33	do	
Mauldin	49 18.46	38 05.09	do	Do.
Paris	56 29.27	24 40.05	do	Do.

GEORGIA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	34°-35°	83°-84°		
	° ′ ″	° ′ ″		
Blood	34 44 23.24	83 56 13.22	C. & G. S	Bull. 122.
Currahee	31 45.13	22 33.32	do	Do.
Dahlonega Agricultural College, center of roof.	31 47.95	59 13.25	do	
Rabun	57 55.74	17 59.26	do	Do.
Skitt	30 20.55	43 19.83	do	Do.
	34°-35°	84°-85°		
Cohutta	34 53 23.51	84 34 26.44	do	
Grassy	29 10.58	19 53.04	do	Do.
Pine Log	19 18.31	38 13.66	do	Do.
Pine Mountain	10 36.61	44 41.67	do	
Sawnee	14 12.12	09 38.83	do	Do.
Sharp Top Mountain	26 21.00	30 26.00	do	
Sweat	04 01.44	27 21.54	do	Do.
	34°-35°	85°-86°		
Coosa	34 13 59.30	85 14 04.32	do	
Gulf	37 32.16	28 02.49	do	Do.
High Point	51 49.80	23 32.70	G. S	Do.
Johns Mountain	37 23.23	05 53.77	C. & G. S	Do.
Mount Lavender	19 19.57	17 18.39	do	Do.
Rocky Face	49 26.30	00 28.10	G. S	Do.

GEORGIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°–34°	81°–82°		
Augusta:	° ′ ″	° ′ ″		
Astronomical station in post-office grounds.	33 28 20.60	81 57 55.40	C. & G. S	
Post-office flagstaff	28 22.18	57 53.96	do	
	33°–34°	83°–84°		
Academy	33 57 32.66	83 59 28.51	do	
Atlanta:	33°–34°	84°–85°		
Barracks flagstaff	33 44 38.99	84 24 39.95	do	
Capitol flagstaff	45 19.32	23 29.15	do	
Carnes Mountain	59 35.76	00 50.03	do	
Kenesaw	58 34.37	34 45.74	do	
Lost Mountain	56 52.74	41 50.75	do	
Marietta:				
Court-house, brown spire	57 08.74	32 55.92	do	
National Cemetery flagstaff	57 04.15	32 30.66	do	
Middle base	54 21.74	16 37.79	do	
Northeast base	55 57.86	14 09.44	do	
Southwest base	52 51.83	18 56.41	do	
Stone Mountain	48 22.07	08 45.89	do	
	32°–33°	83°–84°		
Macon, transit near Academy	32 50 25.38	83 37 33.82	do	

FLORIDA.

	29°–30°	82°–83°		
Gainesville:	° ′ ″	° ′ ″		
Astronomic station	29 39 07.90	82 19 20.90	C. & G. S	
Court-house rod	39 04.53	19 23.80	do	
	29°–30°	84°–85°		
Apalachicola, flagstaff	29 43 30.00	84 59 00.00	do	
	27°–28°	82°–83°		
Alafia	27 50 04.46	82 23 22.06	do	
Ball	54 23.27	24 51.27	do	
Catfish Point	50 43.47	28 06.75	do	
Fort Brooks, barracks cupola	56 33.24	27 21.57	do	
Gadsden Point	49 19.74	28 15.05	do	
Geode	53 19.96	28 43.30	do	
Island	55 24.73	27 07.72	do	
Stick	53 23.90	24 19.60	do	
Old	51 52.11	23 58.72	do	

ALABAMA.

	34°–35°	85°–86°		
	° ′ ″	° ′ ″		
Brandon	34 23 07.35	85 45 12.72	C. & G. S	Bull. 122.
Indian	01 49.94	25 31.10	do	Do.
Weisner	01 35.63	40 27.43	do	
	34°–35°	86°–87°		
Athens, court-house spire	34 48 10.56	86 58 17.46	do	
Aurora	08 47.87	11 00.80	do	
Capshaw	49 04.47	44 17.40	do	
Gunter	34 06.83	10 20.30	do	Do.
Huntsville:				
Episcopal church spire	43 49.38	35 00.20	do	
Cupola of court-house	43 49.09	35 06.02	do	
Knob Valhermosa	30 53.15	38 36.93	do	
Madkin Mountain-tree	40 02.10	38 37.38	do	
Monte Sano, north end	44 52.10	32 03.54	do	
Moore Hill	21 32.50	15 53.56	do	
Rowe Mountain	32 22.32	31 26.59	do	
Smither	48 59.29	36 58.34	do	
Summit	12 16.36	29 05.20	do	
Wilson Mountain	25 07.51	49 02.85	do	
	34°–35°	87°–88°		
Penit	34 26 08.90	87 20 14.29	do	
	33°–34°	85°–86°		
Chehahaw	33 29 08.03	85 48 31.14	do	
	33°–34°	86°–87°		
Alpine	33 24 41.50	86 12 28.20	do	
Cahaba	44 58.80	31 24.60	do	

ALABAMA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	33°-34°			86°-87°				
	°	′	″	°	′	″		
Columbian	33	11	40.80	86	35	00.70	C. & G. S	
Horn		17	51.40		04	29.70	do	
Kahatchee		13	36.80		21	38.60	do	
Laurel		23	50.20		34	53.80	do	
Warnock		59	48.67		41	51.96	do	
	32°-33°			86°-87°				
Jamison	32	55	39.20	86	38	38.40	do	
Montgomery		22	45.46		17	57.29	do	Rept. '84.
Weogufka		58	38.70		21	20.20	do	Do.
Wilder		38	01.77		29	38.53	do	Do.
	31°-32°			85°-86°				
Eufaula	31	53	40.91	85	08	18.62	do	Do.

MISSISSIPPI.

	34°-35°			90°-91°				
	°	′	″	°	′	″		
Adams	34	34	15.16	90	33	57.10	Miss. R. C	Rept. '87.
Alexander		43	16.01		30	39.08	do	Do.
Anderson		08	57.54		53	14.45	do	Rept. '82.
Australia		04	01.51		53	17.63	do	Do.
Battle Island		39	02.60		28	59.63	do	Rept. '87.
Belfor		28	32.01		34	05.72	do	Rept. '82.
Bennett		50	49.74		20	06.11	do	Rept. '87.
Bowie Point		50	45.81		21	31.44	do	Do.
Bordeaux Chute		44	52.78		30	12.88	do	Do.
Brinkley		45	45.18		25	25.75	do	Do.
Buck Island		51	37.17		18	55.16	do	Do.
Chute		52	11.57		18	13.53	do	Do.
Buckshot		35	32.69		33	13.97	do	Do.
Buzzard		16	06.23		47	50.96	do	Rept. '82.
Carter		44	53.77		29	33.76	do	Rept. '87.
Cemetery		32	36.78		35	36.59	do	Rept. '82.
Clark		47	37.99		26	03.07	do	Rept. '87.
Commerce		48	55.18		26	09.27	do	Do.
Cottonwood		51	22.86		21	45.26	do	Do.
Crews		07	08.75		56	05.31	do	Rept. '82.
Delta		24	44.55		35	11.90	do	Do.
Dennis		02	15.36		54	17.38	do	Do.
Donaldson		13	49.01		51	31.98	do	Do.
Dyers		02	55.05		53	39.02	do	Do.
Frederick		40	09.42		27	33.19	do	Rept. '87.
Friar Point		22	54.28		37	53.29	do	Rept. '82.
Glendale		30	09.51		34	19.11	do	Do.
Grider		54	59.21		15	59.59	do	Rept. '87.
Gratlin		11	53.25		50	54.04	do	Rept. '82.
Harcklerode		56	29.35		14	40.59	do	Rept. '87.
Helena Island		34	41.48		32	16.20	do	Do.
Horseshoe Lake		52	41.57		18	31.27	do	Do.
Hulberton		17	07.70		47	02.72	do	Rept. '82.
Hurricane Point		02	04.31		55	07.21	do	Do.
Island 64		14	26.29		51	10.74	do	Do.
Island 66		10	58.31		49	36.36	do	Do.
Island 69		04	36.71		54	14.06	do	Do.
Jackson Point		14	10.52		52	49.62	do	Do.
John H		54	15.75		17	13.95	do	Rept. '87.
Jones		10	05.69		49	21.65	do	Rept. '82.
Lamb		55	11.65		15	13.72	do	Rept. '87.
Lucker		21	29.59		41	15.70	do	Rept. '82.
Magenta		01	54.29		56	08.87	do	Do.
Malone		08	43.89		51	55.52	do	Do.
Miller Point		22	29.43		42	40.86	do	Do.
Montezuma		26	25.63		35	04.60	do	Do.
Moon Lake		44	18.52		27	02.10	do	Rept. '87.
New Hope		08	40.33		50	57.01	do	Rept. '82.
Oasis		00	27.02		57	15.61	do	Do.
O. K		38	02.19		28	52.78	do	Rept. '87.
Overflow		19	57.67		44	05.46	do	Rept. '82.
Parker		06	35.55		55	25.05	do	Do.
Perry		42	10.17		29	33.42	do	Rept. '87.
Platon		44	22.15		30	39.14	do	Do.
Polk		50	40.81		22	46.48	do	Do.
Pushmataha		09	19.85		55	21.60	do	Rept. '82.
Quitman		11	50.49		52	03.50	do	Do.
Richardson		11	47.29		49	12.65	do	Do.
Robinsonville		09	10.79		49	09.90	do	Do.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	34°-35°			90°-91°				
	°	′	″	°	′	″		
Robson	34	15	00.53	90	48	56.60	Miss. R. C	Rept. '82.
Rozzell		23	23.01		36	55.84	do	Do.
Russell		18	39.71		43	36.73	do	Do.
St. Johns		05	29.39		54	02.32	do	Do.
Sand Point		49	52.64		24	30.51	do	Rept. '87.
Sandford		01	04.44		56	56.25	do	Rept. '82.
Ship		21	43.15		38	57.13	do	Do.
Shoo-Fly		38	55.08		31	23.40	do	Rept. '87.
Star Landing		54	14.02		15	56.80	do	Do.
State Land		20	48.90		44	28.32	do	Rept. '82.
State Levee		13	55.44		50	36.04	do	Do.
State Line		58	50.03		16	29.40	do	Rept. '87.
Sunflower Landing		10	23.83		48	37.70	do	Rept. '82.
Turner		38	29.74		33	50.58	do	Rept. '87.
Ude		32	12.74		33	44.53	do C. & G. S.	Rept. '82.
Wilkinson		21	58.88		44	36.95	Miss. R. C	Do.
Williams		52	36.22		17	31.83	do	Rept. '87.
Yazoo Pass		26	16.44		33	18.66	do	Rept. '82.
	34°-35°			91°-92°				
Smith Point	34	00	16.86	91	02	20.43	do	Do.
	33°-34°			90°-91°				
Bee Hive	33	59	00.01	90	59	51.11	do	Do.
Brandenburg		59	04.45		58	15.48	do	Do.
Hill		58	44.65		59	13.45	do	Do.
Island 71		59	36.32		57	55.16	do	Do.
Judge E		57	55.68		58	26.05	do	Do.
North Base		59	52.48		56	44.91	do	Do.
R. Jones		58	27.85		59	56.60	do	Do.
South Base		59	11.37		57	01.86	do	Do.
	33°-34°			91°-92°				
Antler	33	59	20.92	91	01	23.58	do	Do.
Argyle		26	56.00		04	47.15	do	Do.
Ashbrook		28	45.81		13	03.28	do	Do.
Ashland		27	54.03		07	13.05	do	Do.
Bar		03	02.17		08	32.72	do	Rept. '87.
Bar Point		35	05.36		12	43.41	do	Rept. '82.
Barnes		27	23.83		12	12.93	do	Do.
Beulah Lake		48	03.19		03	40.71	do	Do.
Buck Ridge		39	57.49		04	30.87	do	Do.
Campbell		26	54.00		05	48.00	do	Do.
Carolina		00	37.13		09	12.36	do	Rept. '87.
Gin, northwest gable		00	39.45		09	05.19	do	Do.
Carter		26	14.45		07	06.06	do	Rept. '82.
Catfish Point		42	00.56		09	12.12	do	Do.
Chaff		08	43.77		06	02.10	do	Rept. '87.
Childers		38	09.99		08	33.13	do	Rept. '82.
Compton		16	00.59		06	51.26	do	Rept. '87.
Concordia Bayou		58	21.37		02	48.89	do	Rept. '82.
Content		39	55.07		07	05.07	do	Do.
Cottage		08	06.06		09	26.41	do	Rept. '87.
Craig's gin chimney		22	19.57		08	34.82	do	Do.
Crow Point		46	09.61		07	57.18	do	Rept. '82.
Cypress Tow Head		42	30.01		11	32.55	do	Do.
Deer Point		43	00.14		04	56.05	do	Do.
Delolme		35	54.63		10	19.27	do	Do.
Dry Chute		44	03.73		07	13.14	do	Do.
Duncan		33	05.78		12	46.47	do	Do.
Easton		36	38.67		07	57.83	do	Do.
Eutaw		38	54.64		09	36.14	do	Do.
Eutopiot		29	53.98		11	33.30	do	Do.
Ezell		52	32.69		02	53.38	do	Do.
Fisher		45	30.82		05	56.25	do	Do.
Floryville		51	07.77		01	59.48	do	Do.
Gill		59	07.89		03	37.70	do	Do.
Glenora		11	53.28		04	44.11	do	Rept. '87.
Gin chimney		11	12.52		04	07.66	do	Do.
Greenville:								
Episcopal church spire		24	40.21		03	57.30	do	Do.
Base, north end		24	19.23		03	58.77	do	Do.
Base, south end		23	18.19		04	32.44	do	Do.
Highland		21	14.06		08	23.76	do	Do.
Hill		08	11.60		07	52.24	do	Do.
Island 76		40	22.36		03	24.90	do	Rept. '82.
Island 77		41	43.10		11	57.41	do	Do.
Island 80		30	46.72		12	17.70	do	Do.
Island 81		29	50.55		12	37.55	do	Do.
Island 84		18	59.03		09	25.70	do	Rept. '87.
Ivy Point		34	16.25		13	01.40	do	Rept. '82.
Jack		22	22.04		05	54.04	do	Rept. '87.

MISSISSIPPI—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°-34°	91°-92°		
	° ′ ″	° ′ ″		
Kentucky Landing	33 39 46.90	91 05 42.98	Miss. R. C	Rept. '82.
Kershaw	02 01.44	08 50.00	do	Rept '87.
Leota	04 27.98	08 54.46	do	Do.
Levee	09 26.63	05 11.49	do	Do.
Meadow Point	44 53.78	08 04.88	do	Rept. '82.
Miller Bend	28 54.16	07 27.44	do	Do.
Mohawk Landing	42 51.73	03 37.01	do	Do.
Morris	29 37.74	08 20.50	do	Do.
Moss Lake	29 47.97	10 29.28	do	Do.
Mound Place	35 50.78	08 59.88	do	Do.
North base	24 19.23	03 58.77	do C. & G. S.	Do.
North Island 82	29 09.51	09 37.92	Miss. R. C	Do.
Offutt	31 04.79	11 20.36	do	Do.
Peak	58 47.54	00 28.14	do	Do.
Phillips	28 47.73	11 26.47	do	Do.
Pigeon Point	40 33.15	11 42.54	do	Do.
Port Anderson	32 14.79	11 59.37	do	Do.
Prentiss	46 37.58	04 15.29	do	Do.
Pride Point	49 32.50	02 45.10	do	Do.
Quarters	10 33.09	04 35.12	do	Rept. '87.
Randolph	26 23.23	08 00.57	do	Rept. '82.
Refuge	17 31.03	08 06.68	do	Rept. '87.
Post-office chimney	17 34.38	08 06.14	do	Do.
Oilworks, cupola	17 20.80	07 55.66	do	Do.
Richardson	21 46.29	06 30.37	do	Do.
Rock Head	39 38.01	11 01.39	do	Rept. '82.
Sand Point	27 45.79	13 14.60	do	Do.
Sedge	13 08.19	05 42.62	do	Rept. '87.
Shady Side	30 07.24	09 09.88	do	Rept. '82.
Shelby	35 47.49	11 32.11	do	Do.
House, chimney	17 44.83	08 07.95	do	Rept. '87.
Singer	42 37.47	10 27.39	do	Rept. '82.
Solona	25 48.37	07 34.70	do	Do.
South Base	23 18.19	04 32.44	do	Do.
South Island 82	27 20.47	08 11.60	do	Do.
Stella, warehouse gable	09 03.04	05 24.89	do	Rept. '87.
Stokes	56 01.30	02 06.02	do	Rept. '82.
Telegraph	09 51.84	04 32.80	do	Rept. '87.
Terrene	54 01.73	03 21.28	do	Rept. '82.
Torpley	26 54.68	07 37.91	do	Do.
Victoria	57 46.70	02 26.67	do	Do.
Walnut Point	14 08.83	06 50.71	do	Rept. '87.
Warfield	20 16.41	09 33.52	do	Do.
Waxhaw	54 52.72	02 53.36	do	Rept. '82.
Wickliffe	07 44.33	10 33.42	do	Rept. '87.
Widow	59 37.32	03 47.05	do	Rept. '82.
Wildwood	45 32.29	07 22.71	do	Do.
Williams, chimney	10 57.25	04 25.98	do	Rept. '87.
Willow Point	43 19.48	05 57.40	do	Rept. '82.
Worthington	06 24.70	10 03.48	do	Rept. '87.
Balcony	05 21.84	09 15.06	do	Do.
Wrights Point, No. 2	48 56.28	03 28.82	do	Rept. '82.
Base:	32°-33°	90°-91°		
Northeast end (delta)	32 20 01.61	90 54 53.95	do	Rept. '87.
Southwest end (delta)	19 04.60	56 13.19	do	Do.
Big Bayou	16 02.11	56 34.22	do	Do.
Charley	13 42.30	58 28.56	do	Do.
Delta:			do	Do.
Court-house, flagstaff at east end	19 06.08	56 13.41		
Engine-house cupola	19 34.43	55 30.53	do	Do.
Fort	20 26.16	53 05.04	do	Do.
Hutchinson	21 09.42	57 40.78	do	Do.
Island	21 07.11	53 41.73	do	Do.
Kemp	17 25.10	56 01.84	do	Do.
King	20 35.58	56 37.18	do	Do.
King (Mrs.), house cupola	20 37.15	56 36.86	do	Do.
McGee	23 03.23	52 57.11	do	Do.
Myer	13 44.93	57 10.77	do	Do.
New house, south gable	21 12.24	57 38.86	do	Do.
New King	20 38.82	56 46.03	do	Do.
Simrall	13 00.14	58 36.07	do	Do.
Vicksburg:				
Catholic church spire	20 54.63	52 54.68	do	Do.
Court-house cupola	21 05.41	52 45.16	do	Do.
Methodist church spire	20 52.15	52 46.41	do	Do.
National cemetery flagstaff	22 25.38	52 06.45	do	Do.
Trinity church spire	20 49.18	52 49.49	do	Do.
Walnut, house chimney	18 01.69	54 32.39	do	Do.
Waddel, house, southeast chimney	21 01.60	59 19.49	do	Do.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	32°-33°			90°-91°				
	°	'	''	°	'	''		
Warrenton	32	14	54.78	90	56	35.30	Miss. R. C.	Rept. '87.
Yazoo		22	07.81		59	10.54	do	Do.
	32°-33°			91°-92°				
Albemarle	32	37	14.10	91	02	00.70	do	Do.
Arcadia		39	56.17		08	25.81	do	Do.
Benham, southeast chimney		51	27.07		07	17.06	do	Do.
Ben Lomond, gin chimney		47	49.62		08	35.32	do	Do.
Big Black		06	35.45		02	34.07	do	Do.
Brunswick		34	31.83		03	51.56	do	Do.
Burleigh		37	53.84		04	05.56	do	Do.
Cabin Home		35	24.87		02	18.60	do	Do.
Cannon		08	15.19		02	33.23	do	Do.
Cordell		58	28.43		07	55.05	do	Do.
Cotton gin		37	56.93		02	59.22	do	Do.
Duncan		51	09.11		06	19.57	do	Do.
Duncannon:								
Gin chimney		50	22.44		06	18.74	do	Do.
Gin ventilator		49	43.49		06	47.56	do	Do.
Duncansby		57	47.00		05	35.65	do	Do.
Eagle		29	56.43		06	29.44	do	Do.
Elder		05	10.25		03	21.17	do	Do.
Farland		45	00.11		05	35.47	do	Do.
Gander		07	34.12		03	36.38	do	Do.
Gantt		13	02.34		00	28.53	do	Do.
Grand Gulf Island		01	34.56		04	59.75	do	Do.
Green		56	07.07		04	38.54	do	Do.
Guy		11	43.57		01	31.81	do	Do.
Gynn		34	11.08		04	34.11	do	Do.
Hall, store, west gable		43	10.68		03	49.89	do	Do.
Hankinson		12	14.84		01	42.17	do	Do.
Hays		42	42.11		04	19.86	do	Do.
Hughes		00	30.27		05	57.88	do	Do.
Ingersoll		45	57.86		08	55.75	do	Do.
Levee		25	25.23		01	15.48	do	Do.
Lewis		58	27.35		09	13.76	do	Do.
House, chimney, north end		58	30.98		09	18.28	do	Do.
Mayerville, warehouse, northeast gable.		54	00.98		03	30.48	do	Do.
Mayersville		54	20.22		04	08.53	do	Do.
McBurney		27	42.24		02	11.12	do	Do.
Melbourne, chimney		38	39.97		10	14.72	do	Do.
Montgomery, house, cupola		45	55.01		10	09.12	do	Do.
Morgan		08	52.55		00	54.77	do	Do.
No Place		37	50.46		07	59.15	do	Do.
North 95		44	41.02		04	48.80	do	Do.
Oakland, gin chimney		50	46.72		06	00.44	do	Do.
Poverty Point		59	15.82		12	28.57	do	Do.
Powell, house, southeast chimney		42	58.34		03	59.76	do	Do.
Pugh		25	05.92		00	22.92	do	Do.
Purvis		27	57.47		08	22.04	do	Do.
Richardson		59	37.09		10	44.61	do	Do.
Sand Bar		35	03.73		03	14.56	do	Do.
Sand Island		28	39.08		04	59.09	do	Do.
Sarah Island		58	19.39		11	20.24	do	Do.
Sartoris		48	01.67		08	55.08	do	Do.
Shiloh		41	49.58		05	31.27	do	Do.
Shipland		44	52.53		07	14.16	do	Do.
Shoot		38	15.41		08	37.55	do	Do.
Short		46	29.19		10	06.62	do	Do.
South 95		43	42.89		04	10.32	do	Do.
Stock Island		49	33.32		07	50.00	do	Do.
Swamp		04	39.54		04	48.38	do	Do.
Sycamore		04	39.46		06	26.06	do	Do.
Tennessee		37	50.08		06	11.00	do	Do.
Gin chimney		38	12.62		06	09.67	do	Do.
Thrasher		02	34.17		05	18.64	do	Do.
Walton, 2		13	14.99		01	09.70	do	Do.
Williams		10	28.87		00	30.25	do	Do.
Do		58	12.73		06	39.77	do	Do.
Willows		32	10.40		05	11.60	do	Do.
Winslow		47	08.44		09	06.65	do	Do.
Yucatan Bar		03	46.77		07	35.78	do	Do.
	31°-32°			91°-92°				
Allaway	31	15	43.24	91	34	18.92	do	Do.
Arnolia		33	33.14		26	41.28	do	Do.
Ashland		48	25.37		20	49.40	do	Do.
Bartlett		05	32.79		35	33.21	do	Do.
Bayou Pierre		57	54.70		08	56.12	do	Do.
Block House Hill		04	46.86		32	54.62	do	Do.
Bluff		38	43.85		23	11.93	do	Do.
Gin		01	46.63		32	50.19	do	Do.

MISSISSIPPI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	31°-32°			91°-92°				
	°	′	″	°	′	″		
Bourbon	31	23	20.03	91	28	48.51	Miss. R. C	Rept. '87.
Brenham		37	14.83		25	19.38	do	Do.
Bruinsburg		55	54.05		10	24.75	do	Do.
Buena Vista		49	04.48		19	38.29	do	Do.
Burnett		44	54.48		21	30.97	do	Do.
Butler Bluff		25	20.27		25	42.88	do	Do.
Carthage		31	59.57		27	29.54	do	Do.
Cerro Gordo		15	47.23		32	51.36	do	Do.
Gin stack		15	39.05		32	54.34	do	Do.
Clark		52	35.12		13	34.49	do	Do.
Clarksville, chimney		08	46.04		33	12.48	do	Do.
Cole Island		46	18.22		21	59.24	do	Do.
Corena		20	16.81		31	18.57	do	Do.
Gin stack		19	58.96		31	00.40	do	Do.
Deadman Bend, Government light		16	14.82		31	42.30	do	Do.
Deer Park, gin chimney		24	29.28		33	02.67	do	Do.
Duck Bar		43	02.42		23	24.65	do	Do.
Dunham Bar		36	06.13		26	26.96	do	Do.
Ellis Cliff		24	19.86		26	58.17	do	Do.
Elysian Fields		37	21.58		24	22.72	do	Do.
Fairchild		41	39.86		23	14.21	do	Do.
Faucett		37	40.79		27	09.59	do	Do.
Ferguson		19	20.55		30	59.18	do	Do.
Ford		27	30.24		30	16.29	do	Do.
Forman		50	08.46		13	48.62	do	Do.
Gaither (or Gaither, 2)		33	01.10		26	47.59	do	Do.
Gold Bottom		54	34.07		12	34.26	do	Do.
Harper		23	24.82		29	55.30	do	Do.
Hutchin Landing, Government light		24	22.32		27	09.76	do	Do.
Island		09	21.98		36	52.88	do	Do.
Ivanhoe		28	31.22		30	11.91	do	Do.
Jackson		16	02.50		35	31.66	do	Do.
Do		15	58.65		36	17 59	do	Do.
Gin		16	04.98		36	12.52	do	Do.
Kienstra		13	31.23		36	23.92	do	Do.
Chimney		13	39.34		36	23.84	do	Do.
Lower store		13	17.58		36	14.82	do	Do.
Upper store		13	33.71		36	23.59	do	Do.
Lemley		30	00.35		29	38.55	do	Do.
Leonard		23	09.30		31	44.53	do	Do.
Loch Seven		10	15.20		36	45.61	do	Do.
Gin		10	27.06		36	29.83	do	Do.
Landing		10	07.72		36	49.78	do	Do.
Lookout		33	12.15		26	41.28	do	Do.
Do		33	12.15		25	10.76	do	Do.
Minor		31	01.78		29	02.11	do	Do.
Natchez:								
Astronomical station, transit of 1878.		33	27.16		24	05.20	do	Do.
Catholic church spire cross		33	28.70		24	06.75	do	Do.
Page		25	40.84		28	47.63	do	Do.
Palmetto		21	00.15		32	00.02	do	Do.
Palo Alto (or Palo Alto, 2)		34	46.02		25	09.80	do	Do.
Peach Grove		11	35.34		35	49.78	do	Do.
Point		16	09.55		36	25.05	do	Do.
Quitman		40	37.87		22	56.52	do	Do.
Riverside, chimney		03	18.97		30	46.10	do	Do.
Rock Hill		02	09.86		33	20.32	do	Do.
Rodney		51	14.86		12	26.35	do	Do.
St. Catharine		26	13.22		29	49.03	do	Do.
Sandy Point		53	44.86		13	43.19	do	Do.
Saunders		58	40.26		08	23.30	do	Do.
Service		47	06.89		21	59.94	do	Do.
Shields		25	12.65		29	47.96	do	Do.
Government light near		25	19.17		30	16.12	do	Do.
Spithead		49	23.56		18	01.30	do	Do.
Stamp		06	49.74		36	00.20	do	Do.
Strothers		18	42.59		30	54.58	do	Do.
Surgett		24	20.02		28	48.14	do	Do.
Tarbert		00	21.36		35	59.96	do	Do.
House		01	14.69		35	20.65	do	Do.
Stable		00	57.96		35	29.52	do	Do.
Tall Pine		26	07.65		26	05.19	do	Do.
Ville		18	01.73		30	53.00	do	Do.
Walton, gin chimney		20	23.07		32	13.48	do	Do.
Waveland		58	02.29		09	43.67	do	Do.
Whitehall chute		59	56.94		07	22.34	do	Do.
Wilson		43	34.95		22	58.45	do	Do.
Winn		17	25.64		30	59.52	do	Do.
Wood yard, house chimney		16	21.25		34	30.09	do	Do.

LOUISIANA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	32°-33°			90°-91°				
	°	′	″	°	′	″		
Crane	32	20	36.30	90	57	57.10	Miss. R. C	Rept. '87.
Last		15	53.70		57	47.92	do	Do.
Mattingly		20	44.06		59	05.67	do	Do.
North Bedford		15	23.65		57	09.72	do	Do.
Reade		16	48.24		57	41.30	do	Do.
South Bedford		14	39.35		57	38.20	do	Do.
Williams		19	52.64		58	09.23	do	Do.
	32°-33°			91°-92°				
Airlie	32	37	55.65	91	09	30.26	do	Do.
Arlington		48	25.27		09	44.64	do	Do.
Ashton		59	40.32		13	00.20	do	Do.
Bass		42	53.97		04	54.08	do	Do.
Biggs		17	54.94		57	27.43	do	Do.
Broozowski (Dr.), house chimney		23	41.46		00	55.48	do	Do.
Byrne		27	09.22		04	25.47	do	Do.
Church spire		37	05.13		04	26.90	do	Do.
Concord		42	17.66		06	01.28	do	Do.
Coons		11	38.08		02	12.91	do	Do.
Cottonwood		54	06.62		05	10.95	do	Do.
Gin chimney		53	16.30		06	05.50	do	Do.
Crandall		01	44.04		05	35.00	do	Do.
Creswell		29	53.90		07	32.67	do	Do.
Deer		44	29.05		05	23.12	do	Do.
Diamond		44	21.86		06	14.23	do	Do.
Diamond Island		13	45.91		01	25.52	do	Do.
Disharoon		01	00.44		06	16.25	do	Do.
Dillon		28	53.47		07	01.71	do	Do.
Edgewood		37	08.71		07	57.08	do	Do.
Elton		50	01.32		08	42.65	do	Do.
Gin gable		50	08.90		08	59.17	do	Do.
Middle dormer window		49	58.44		09	07.30	do	Do.
Exern		43	53.73		08	27.68	do	Do.
Foster		36	01.69		03	14.00	do	Do.
Gin cupola		36	49.75		05	05.21	do	Do.
Chimney		36	57.97		05	08.19	do	Do.
Friedlander		58	54.92		13	25.38	do	Do.
Goodrich, Odd Fellows' hall, north gable.		37	41.51		00	14.05	do	Do.
Grace's store, west gable		57	35.12		04	35.22	do	Do.
Graves, house, center		27	24.31		04	34.68	do	Do.
Goza		57	58.55		12	51.92	do	Do.
Hardin		57	50.40		08	47.84	do	Do.
Hard Times		02	38.27		07	14.25	do	Do.
Henderson		35	00.07		04	12.74	do	Do.
Gin chimney		34	27.93		05	05.12	do	Do.
Hollow Ridge, church spire		51	15.68		05	48.01	do	Do.
Homestead		41	38.96		08	17.27	do	Do.
Homochitto		52	12.27		05	26.26	do	Do.
Illawana post-office, chimney		38	24.19		09	02.19	do	Do.
Imboden's store, chimney		59	28.44		13	09.57	do	Do.
Kellogg		11	06.11		01	44.75	do	Do.
Knight		00	23.85		07	52.03	do	Do.
Lake		25	58.43		02	01.88	do	Do.
Lake Providence:								
Base, north end		48	02.49		10	26.85	do	Do.
Base, south end		47	12.12		10	21.35	do	Do.
Longwood		51	30.85		07	10.50	do	Do.
Gin chimney		51	52.34		08	25.90	do	Do.
Mayer		25	24.56		02	11.02	do	Do.
McCullough's east chimney		53	10.92		05	54.92	do	Do.
Miliken's Bend, church spire		27	30.88		06	07.63	do	Do.
Moore		12	31.37		03	07.41	do	Do.
Morancy		27	56.91		06	08.45	do	Do.
Morency's house, northeast chimney		28	14.48		06	25.70	do	Do
Munce		06	07.52		03	44.83	do	Do
Myers's store, south chimney		37	48.80		03	00.16	do	Dc
Newman		37	01.53		03	44.87	do	D
Nichols		21	48.94		00	09.37	do	D
Old River		09	06.86		02	16.60	do	D
Omega		31	02.06		07	28.69	do	D
Owen's store, chimney		57	40.03		11	24.89	do	I
Pilcher's Point		57	43.94		11	25.28	do	I
Point Lookout		43	36.00		04	41.33	do	I
Point Pleasant		07	53.77		04	42.77	do	
Possum Point		57	10.85		06	40.40	do	
Chimney		57	05.60		06	33.24	do	
Raleigh		36	56.27		05	58.39	do	
River Light		55	28.31		04	14.88	do	
Scott		57	41.44		08	00.48	do	
Small house, west gable		55	27.65		04	14.52	do	
Stamboul		40	31.33		09	54.43	do	

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	32°-33°			91°-92°				
	°	′	″	°	′	″		
Terrapin	32	32	58.21	91	06	01.35	Miss. R. C	Rept. '87.
Utz		23	03.09		00	58.41	do	Do.
Villa Vista		34	13.50		05	22.02	do	Do.
Vista		52	37.63		06	15.04	do	Do.
Gin chimney		52	11.34		06	53.72	do	Do.
Wilkinson		10	21.81		01	20.27	do	Do.
Wilson		03	46.77		07	35.78	do	Do.
Wilson's Point		56	03.14		05	20.33	do	Do.
Gin chimney		55	42.84		05	26.80	do	Do.
Wilton		39	24.57		10	23.39	do	Do.
Wyly		45	24.16		10	05.91	do	Do.
Wyly's house, east gable		45	23.44		10	26.13	do	Do.
	31°-32°			91°-92°				
Ashley	31	25	48.00	91	31	15.46	do	Do.
Gin chimney		26	11.13		31	29.94	do	Do.
(Below) Government light		24	33.86		31	05.13	do	Do.
Ballamagan		06	46.76		36	45.05	do	Do.
Black Hawk		09	23.57		37	34.04	do	Do.
Gin		09	32.43		37	50.68	do	Do.
Bondurant		56	33.20		11	03.84	do	Do.
Bougere		16	42.70		36	58.09	do	Do.
Chimney		16	44.87		36	53.99	do	Do.
Gin		16	48.41		36	53.20	do	Do.
Bullock		37	33.69		28	57.89	do	Do.
Cabin		15	32.76		38	12.69	do	Do.
Canebrake		42	00.20		24	09.95	do	Do.
Connor		37	51.44		25	35.93	do	Do.
Conti		30	14.55		30	31.04	do	Do.
Coochee		05	42.17		36	23.84	do	Do.
Crothers		28	26.02		31	44.18	do	Do.
House chimney		28	47.63		31	01.03	do	Do.
(North of) smokestack		28	43.86		31	08.80	do	Do.
(Near) ginhouse stack		28	10.96		31	21.33	do	Do.
(North of) belfry		28	42.74		31	10.38	do	Do.
CXI Bar		50	28.38		14	19.93	do	Do.
Davis		39	46.75		23	37.62	do	Do.
Down-river, dovecot		28	46.92		30	58.17	do	Do.
Esperance		25	00.35		28	47.88	do	Do.
Fairview		24	27.65		31	54.01	do	Do.
Fairview Landing, river front of new store.		19	49.76		31	51.22	do	Do.
Fritz		16	58.51		31	52.29	do	Do.
Gillespie		55	14.20		12	53.00	do	Do.
Glasscock		21	00.48		33	37.95	do	Do.
Golman		48	55.29		21	18.77	do	Do.
Goodhope		38	17.82		27	20.68	do	Do.
Hard Scrabble		58	50.95		09	02.30	do	Do.
Harpers Island		50	31.62		16	01.82	do	Do.
Hole in Wall		43	13.71		24	09.46	do	Do.
Home Place		16	19.66		33	47.93	do	Do.
Store gable		16	22.29		33	48.08	do	Do.
Kemps Landing		49	47.47		19	44.54	do	Do.
Kers Point		00	49.32		36	47.88	do	Do.
Langside:								
Chimney		01	58.56		34	44.22	do	Do.
Gin		01	46.27		34	40.29	do	Do.
L'Argent		44	28.46		23	42.49	do	Do.
Lees Point		51	06.88		13	15.05	do	Do.
Lewis		52	24.36		14	22.01	do	Do.
Lum		02	52.85		34	44.81	do	Do.
Lums Point, base:								
Southwest end, astronomical station.		02	29.11		35	17.08	do	Do.
Northeast end		03	13.73		34	26.42	do	Do.
McElroy		16	10.43		31	43.27	do	Do.
Moro		29	10.85		30	40.38	do	Do.
Natchez		31	25.99		30	20.20	do	Do.
Natchez Island, Government light		30	14.07		30	30.86	do	Do.
Obers		18	49.54		31	42.21	do	Do.
Gin chimney		18	28.02		32	26.78	do	Do.
Pecan		14	54.47		38	04.35	do	Do.
Do		24	21.73		30	30.91	do	Do.
Point Breeze		04	15.82		33	45.78	do	Do.
Pullen		09	56.98		37	33.25	do	Do.
Race course		45	59.34		22	44.55	do	Do.
Roseland		20	05.55		32	21.10	do	Do.
Gin chimney		19	27.26		31	50.03	do	Do.
Rosenthal		22	48.93		34	11.85	do	Do.
Store, river end		23	51.54		33	24.82	do	Do.
St. Joseph		54	04.73		14	20.91	do	Do.
Shamrock		40	30.20		23	44.48	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	31°-32°			91°-92°				
	°	′	″	°	′	″		
Tower	31	13	04.87	91	37	35.91	Miss. R. C	Rept. '87.
Tregar		00	15.26		37	32.29	do	Do.
Union Point		13	33.23		37	07.33	do	Do.
Gin		12	51.92		37	43.16	do	Do.
Up-river, dovecot		28	47.87		30	57.94	do	Do.
Vancluse		38	43.86		23	55.90	do	Do.
Vidalia:								
West end base		36	04.48		26	24.01	do	Do.
Do		35	01.02		26	24.01	do	Do.
East end base		33	42.59		25	18.00	do	Do.
Warnicott		27	15.89		31	15.25	do	Do.
(Near) gin chimney		27	09.40		31	40.96	do	Do.
Waterloo, 2		36	19.80		28	41.39	do	Do.
Waterproof		48	05.39		22	56.59	do	Do.
Watson		55	42.60		11	58.96	do	Do.
Whitehall		32	23.44		28	31.19	do	Do.
Wilds		16	30.13		35	07.85	do	Do.
	30°-31°			90°-91°				
Anderson	30	04	09.38	90	54	48.47	do	Do
Sugarhouse chimney		03	31.15		55	04.63	do	Do.
Ashland, sugarhouse chimney		10	59.90		59	14.96	do	Do.
Bowden		09	39.47		59	40.71	do	Do.
Sugarhouse chimney		09	36.64		59	01.07	do	Do.
Brand, sugarhouse chimney		06	00.47		54	05.02	do	Do.
Brulé, sugarhouse chimney		08	31.54		53	15.42	do	Do.
Burnside		09	52.19		55	55.82	do	Do.
Clark pump chimney		08	12.41		55	25.68	do	Do.
Cofield, sugarhouse chimney		07	53.23		55	58.42	do	Do.
Colomb, bagasse burner		04	30.60		50	46.33	do	Do.
Conway, sugarhouse chimney		09	10.86		54	41.79	do	Do.
Donaldson, sugarhouse chimney		09	03.97		55	58.42	do	Do.
Donaldsonville:								
Baptist church		06	11.54		59	18.79	do	Do.
Methodist church		06	15.28		59	25.48	do	Do.
Cross on convent		06	14.36		59	05.47	do	Do.
Cupola of Lemann's block		06	25.81		59	13.37	do	Do.
Catholic church, east tower		06	18.05		58	58.25	do	Do.
Base, north end		06	11.22		57	54.89	do	Do.
Base, south end		04	23.90		58	10.57	do	Do.
Dugas, sugarhouse, east chimney		05	55.55		58	11.01	do	Do.
Garnier, bagasse burner		03	23.15		52	32.56	do	Do.
Hampton		05	12.13		53	07.46	do	Do.
Hermitage, sugarhouse chimney		06	59.43		57	48.23	do	Do.
Houmas, sugarhouse chimney		07	27.27		54	26.23	do	Do.
Ice factory, chimney		06	16.71		58	30.70	do	Do.
Lauderdal, sugarhouse chimney		04	28.03		55	10.87	do	Do.
Leblanc:								
Bagasse burner		04	59.64		55	41.57	do	Do.
Sugarhouse, south chimney		07	46.75		59	34.41	do	Do.
Lemann		06	30.61		55	39.23	do	Do.
Sugarhouse chimney		05	49.57		59	01.67	do	Do.
Minlor, sugarhouse chimney		04	47.63		52	02.99	do	Do.
Nelmo		57	51.60		15	25.67	do	Do.
New Hope, sugarhouse chimney		03	24.54		53	01.37	do	Do.
Orange Grove, sugarhouse chimney		08	50.20		53	54.00	do	Do.
Rapidan, sugarhouse chimney		04	38.26		52	24.02	do	Do.
Riverton		08	37.55		57	21.76	do	Do.
Sugarhouse chimney		08	57.16		56	51.38	do	Do.
St. Ann's chapel		09	06.78		59	42.17	do	Do.
St. Mary's, church cross		05	17.96		54	17.33	do	Do.
St. Victoria, bagasse burner		03	15.69		54	17.09	do	Do.
Salsbury, sugarhouse chimney		05	19.42		55	20.60	do	Do.
Scanlon, sugarhouse chimney		06	12.30		54	09.49	do	Do.
Stella, sugarhouse chimney		05	37.09		57	29.10	do	Do.
Tureaud		07	35.43		54	10.85	do	Do.
Texas		10	26.44		58	16.78	do	Do.
Trist, sugarhouse chimney		04	30.21		53	01.65	do	Do.
Union, sugarhouse chimney		06	40.08		54	14.94	do	Do.
Wallace, sugarhouse chimney		05	39.89		57	58.33	do	Do.
Whitehall, sugarhouse chimney		04	42.21		53	37.38	do	Do.
Winchester, sugarhouse chimney		03	03.34		54	51.18	do	Do.
	30°-31°			91°-92°				
Acklin	30	56	05.52	91	38	10.81	do	Do.
Adelard Landry, sugarhouse chimney.		10	02.25		00	48.96	do	Do.
Alexander Creek		45	28.23		22	22.78	do	Do.
Do		45	34.69		22	19.99	do	Do.
Allsworth		31	27.02		11	53.21	do	Do.
Anchorage		28	56.53		12	01.00	do	Do.
Sugarhouse chimney		29	00.32		12	19.57	do	Do.

LOUISIANA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	30°-31°	91°-92°		
	° ′ ″	° ′ ″		
	30 17 26.38	91 10 03.83	Miss. R. C	Rept. '87.
	57 31.14	39 01.92	do	Do.
a, sugarhouse:				
ith chimney	13 16.99	05 03.88	do	Do.
rth chimney	13 17.46	05 04.02	do	Do.
ton	23 47.41	12 49.12	do	Do.
d, flagstaff	10 23.72	00 07.84	do	Do.
lia	20 09.88	09 36.29	do	Do.
garhouse chimney	19 57.03	09 30.35	do	Do.
d	05 44.77	02 27.88	do	Do.
, sugarhouse chimney	29 48.08	15 36.50	do	Do.
lle, sugarhouse chimney	14 32.32	06 22.29	do	Do.
	19 22.87	11 09.83	do	Do.
	30 54.46	16 25.59	do	Do.
v	36 01.63	19 10.26	do	Do.
v's chimney	47 39.47	31 31.60	do	Do.
Rouge	26 19.00	11 26.42	do	Do.
racks, flagstaff	27 23.45	11 17.33	do	Do.
ronomical and longitudinal tation.	27 18.02	11 17.86	do	Do.
racks, astronomical azimuth tation.	27 28.35	11 24.43	do	Do.
thodist church spire	27 05.76	11 11.56	do	Do.
rth end base	25 59.92	11 24.72	do	Do.
ith end base	25 09.43	11 42.15	do	Do.
te penitentiary, round brick himney.	27 04.21	10 55.59	do	Do.
te House, northwest tower	26 51.56	11 20.29	do	Do.
te University, pole on cupola	26 28.70	11 07.86	do	Do.
e	17 06.00	12 00.05	do	Do.
	28 28.01	11 31.79	do	Do.
Sara:				
thodist church	46 08.34	23 40.59	do	Do.
noolhouse	46 04.52	23 28.22	do	Do.
ne	45 58.17	23 35.43	do	Do.
n chimney	45 59.68	23 23.57	do	Do.
lored church belfry	44 30.99	22 13.59	do	Do.
	30 33.81	12 07.55	do	Do.
garhouse, west chimney	30 29.34	12 25.29	do	Do.
Vale	30 15.85	14 57.85	do	Do.
Vale, sugarhouse chimney	30 15.11	14 50.12	do	Do.
Grove	11 22.14	07 11.89	do	Do.
garhouse chimney	11 06.52	06 55.59	do	Do.
ore, east gable	11 21.67	07 11.85	do	Do.
nt	30 40.21	14 02.45	do	Do.
nt, sugarhouse chimney	29 59.54	14 10.47	do	Do.
	19 26.44	09 37.69	do	Do.
ron	43 44.63	33 42.09	do	Do.
ve	39 50.81	19 08.36	do	Do.
l	44 32.88	27 12.90	do	Do.
Landing church	23 09.92	14 09.27	do	Do.
oir	47 15.11	32 24.97	do	Do.
n	46 42.34	35 31.13	do	Do.
u	25 19.51	12 39.53	do	Do.
garhouse chimney	25 28.09	12 49.23	do	Do.
d	45 06.40	23 58.07	do	Do.
use	45 01.58	23 42.73	do	Do.
garhouse chimney	44 52.52	13 52.06	do	Do.
on	50 59.61	31 07.40	do	Do.
n	36 26.05	18 08.19	do	Do.
able	36 36.95	17 49.82	do	Do.
ide, bagasse burner	08 34.94	02 02.71	do	Do.
sawmill chimney	07 39.98	01 31.59	do	Do.
and	44 26.68	33 57.44	do	Do.
e, sugarhouse chimney	11 29.94	06 19.47	do	Do.
berlain	28 36.84	12 39.84	do	Do.
	32 09.03	17 30.01	do	Do.
w, sugarhouse chimney	11 24.09	03 37.71	do	Do.
orth	20 41.01	09 02.23	do	Do.
garhouse chimney	20 53.56	08 36.12	do	Do.
nam	55 19.37	36 09.66	do	Do.
	31 20.65	17 28.83	do	Do.
h, near Evergreen	16 29.16	11 54.45	do	Do.
re	23 45.79	13 36.63	do	Do.
able lightning rod	23 49.57	13 52.33	do	Do.
rne	11 58.70	04 12.19	do	Do.
garhouse chimney	43 47.36	27 36.87	do	Do.
Do	11 50.01	04 33.92	do	Do.
sugarhouse chimney	33 14.51	17 28.76	do	Do.
	33 57.99	15 42.41	do	Do.
nt	15 59.78	09 47.90	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Coal yard	30	31	05.84	91	14	09.49	Miss. R. C	Rept. '87.
House		55	00.87		34	01.68	do	Do.
Colwell		30	33.08		16	28.16	do	Do.
Sugarhouse chimney		30	24.38		16	17.06	do	Do.
Como		54	30.03		31	53.17	do	Do.
Conrad		18	47.15		11	14.38	do	Do.
Cottage		21	15.31		13	24.29	do	Do.
Sugarhouse chimney		21	26.96		13	37.93	do	Do.
Cotton		49	07.71		31	51.78	do	Do.
Coulon		44	51.94		25	04.25	do	Do.
Crescent		05	17.78		00	20.80	do	Do.
Sugarhouse chimney		04	39.01		01	17.43	do	Do.
Cuba, sugarhouse chimney		11	04.48		02	05.35	do	Do.
Cut Off		55	32.44		37	10.20	do	Do.
Depot, astronomical station		45	52.73		23	18.45	do	Do.
Deserted Cabin		52	40.63		31	14.78	do	Do.
Devall		32	52.58		15	53.62	do	Do.
Dichary		08	23.93		00	31.02	do	Do.
Sugarhouse chimney		08	21.56		00	11.37	do	Do.
Douglas		51	19.84		31	42.77	do	Do.
Doyle's chimney		45	21.07		22	12.68	do	Do.
Duncan		22	07.16		13	55.90	do	Do.
Dupuy		14	42.93		06	42.57	do	Do.
Eastman		58	28.86		38	37.93	do	Do.
Elevator		40	19.62		17	21.84	do	Do.
Evan Hall		07	31.81		02	36.88	do	Do.
Sawmill chimney		07	18.64		02	08.51	do	Do.
Sugarhouse chimney		07	02.28		02	52.87	do	Do.
Evergreen		16	28.82		11	56.98	do	Do.
Fancy Point		40	33.13		19	53.08	do	Do.
Fairot		29	56.62		13	16.57	do	Do.
Ferry		27	10.10		12	01.52	do	Do.
Fisher		44	37.29		31	39.82	do	Do.
Fischer's Landing		47	18.95		34	54.17	do	Do.
Forlorn Hope, sugarhouse chimney		17	24.21		09	25.67	do	Do.
Fort		44	46.30		21	44.36	do	Do.
Frances Gomez, sugarhouse chimney		05	33.27		01	31.75	do	Do.
Gay		16	41.86		12	44.49	do	Do.
Gay's house, lightning rod		26	57.53		12	05.83	do	Do.
Gem, sugarhouse chimney		08	42.08		00	02.69	do	Do.
Glennon		35	16.58		18	48.99	do	Do.
Sugarhouse chimney		34	52.92		19	06.32	do	Do.
Golden Ridge		15	54.89		07	40.50	do	Do.
Gravel		35	30.46		18	06.96	do	Do.
Greenfield, sugarhouse chimney		16	01.09		10	15.40	do	Do.
Hard Times		31	13.33		12	32.88	do	Do.
Sugarhouse chimney		13	15.64		05	13.91	do	Do.
Hereford, sugarhouse chimney		34	16.74		18	27.54	do	Do.
Hicky		20	45.69		14	33.64	do	Do.
Hill		28	26.16		12	00.77	do	Do.
Hog Point		55	36.15		38	42.01	do	Do.
Hog Point Landing		55	50.73		39	00.81	do	Do.
Hollywood, bagasse chimney		21	15.40		10	38.58	do	Do.
Home Place, sugarhouse chimney		09	26.63		00	42.41	do	Do.
Hopkins		43	50.92		30	04.69	do	Do.
Horner		31	22.65		13	21.13	do	Do.
Indian Camp, sugarhouse chimney		11	52.54		07	29.41	do	Do.
Iron chimney		16	04.30		10	40.64	do	Do.
Keller		47	52.99		31	21.61	do	Do.
Kelson		36	45.92		18	44.59	do	Do.
Sugarhouse chimney		37	24.48		18	53.07	do	Do.
Kingsbury		57	27.87		39	45.24	do	Do.
Store		57	24.57		39	46.00	do	Do.
Knox		29	17.00		11	35.75	do	Do.
Labry		42	43.71		21	14.69	do	Do.
Last		34	42.00		16	00.57	do	Do.
Leblanc		07	15.14		00	14.10	do	Do.
Lebret		42	50.09		20	43.24	do	Do.
Leonard		45	12.47		34	55.45	do	Do.
Leperre, sugarhouse chimney		20	28.83		13	11.89	do	Do.
Letherman		54	35.69		33	05.17	do	Do.
Levert		15	52.79		07	23.58	do	Do.
Lieux sawmill		41	31.87		21	05.07	do	Do.
Light-house:								
(Near Chatworth)		20	24.40		08	36.98	do	Do.
(Near Hicky, removed April, 1880)		20	56.19		14	35.79	do	Do.
(Near Woodland)		18	26.28		13	55.02	do	Do.
Limerick		26	09.88		12	12.40	do	Do.
Sugarhouse, north chimney		26	07.17		12	21.85	do	Do.
Sugarhouse, south chimney		26	06.64		12	21.91	do	Do.
Lobdell		34	35.90		17	52.48	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Vood	30	39	57.43	91	18	28.22	Miss. R. C	Rept. '87.
		21	02.41		11	36.36	do	Do.
um's Point		44	10.05		35	46.40	do	Do.
ner :								
vmill chimney		07	44.22		02	11.55	do	Do.
garhouse chimney		07	42.49		02	40.30	do	Do.
liams house lightning rod		19	08.34		12	33.79	do	Do.
		45	50.00		24	09.77	do	Do.
ac		18	59.06		08	51.13	do	Do.
garhouse chimney		18	42.30		08	23.10	do	Do.
		20	21.73		12	11.45	do	Do.
nd		12	33.13		06	15.49	do	Do.
		19	07.26		12	35.95	do	Do.
himney		55	16.66		38	21.88	do	Do.
'oint		55	12.25		37	29.08	do	Do.
ri		22	19.99		14	33.54	do	Do.
e, sugarhouse chimney		10	23.42		01	07.85	do	Do.
Sano		30	38.62		11	35.42	do	Do.
ello		15	38.53		06	25.64	do	Do.
nza		44	11.35		34	46.12	do	Do.
on, sugarhouse chimney		43	28.40		31	37.67	do	Do.
Houmas, sugarhouse chimney		12	11.88		00	41.51	do	Do.
Houmas house, south gable		11	44.14		01	12.85	do	Do.
Pleasant		38	14.70		17	52.34	do	Do.
ble		38	33.40		17	30.79	do	Do.
nding		38	32.16		17	45.62	do	Do.
		38	33.64		17	38.13	do	Do.
ry Grove, sugarhouse chimney		21	15.55		09	54.95	do	Do.
		46	33.43		34	41.99	do	Do.
church or school		35	14.20		18	59.80	do	Do.
ouse		47	21.04		31	47.90	do	Do.
exas		46	54.01		35	13.49	do	Do.
chimney		46	13.00		35	34.22	do	Do.
mney		46	10.77		35	38.08	do	Do.
gstaff		46	28.15		35	28.61	do	Do.
itman statue		46	26.20		35	25.66	do	Do.
ugarhouse chimney		40	57.64		21	04.74	do	Do.
ugarhouse, south chimney		26	50.13		12	19.40	do	Do.
in		46	28.13		35	35.80	do	Do.
lla, sugarhouse chimney		10	41.37		07	35.26	do	Do.
ckory, sugarhouse chimney		11	53.94		05	22.71	do	Do.
ver		54	48.88		36	29.97	do	Do.
ver House		54	48.63		36	36.54	do	Do.
ndred Mile, sugarhouse chim-		14	28.77		06	36.03	do	Do.
a		13	04.60		08	08.43	do	Do.
lto		14	10.26		08	04.73	do	Do.
garhouse chimney		05	37.30		02	23.93	do	Do.
e overseer's house		43	43.58		28	53.75	do	Do.
sugarhouse chimney		09	07.75		01	19.13	do	Do.
mine		17	17.12		13	36.61	do	Do.
holic church spire		17	31.97		14	02.85	do	Do.
		31	24.19		16	50.51	do	Do.
		18	05.54		13	24.99	do	Do.
Coupee base :								
theast end		44	49.20		22	35.00	do	Do.
Do		44	55.65		22	32.22	do	Do.
rthwest end		45	08.63		23	24.03	do	Do.
Pleasant		15	22.95		06	51.73	do	Do.
		27	17.86		11	23.43	do	Do.
		29	21.20		13	52.09	do	Do.
Grove, sugarhouse chimney		29	26.77		12	24.08	do	Do.
		43	10.87		21	21.56	do	Do.
ndson		40	27.00		17	54.10	do	Do.
vmill		40	36.66		17	20.56	do	Do.
anoir		39	50.66		17	58.96	do	Do.
		44	05.82		21	21.56	do	Do.
r chimney		54	47.88		36	07.07	do	Do.
Island		34	56.93		17	50.14	do	Do.
rci Point		47	58.12		32	00.93	do	Do.
n		35	24.70		27	06.86	do	Do.
lph, sugarhouse chimney		35	24.28		19	16.57	do	Do.
iver		58	50.28		39	08.54	do	Do.
hool		58	11.06		39	58.86	do	Do.
ght		58	35.32		39	26.16	do	Do.
rehouse		58	00.20		39	50.16	do	Do.
ore		44	03.49		27	00.30	do	Do.
		12	58.45		04	35.72	do	Do.
garhouse chimney		13	10.88		04	28.91	do	Do.
ue, sugarhouse chimney		13	32.40		03	58.18	do	Do.
Ditch		47	41.24		33	44.22	do	Do.

LOUISIANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	30°-31°			91°-92°				
	°	′	″	°	′	″		
Reynaud	30	34	17.51	91	16	05.26	Miss. R. C	Rept. '87.
Rifle Point		37	58.53		24	58.77	do	Do.
Riley		34	57.47		16	49.10	do	Do.
Riverlight		12	57.41		04	47.57	do	Do.
Rivers		23	39.08		33	19.45	do	Do.
Gin chimney		24	30.72		33	36.30	do	Do.
R. O. Landry, sugarhouse chimney		08	56.24		01	36.25	do	Do.
Rome		06	46.50		00	56.81	do	Do.
Rouzan, sugarhouse chimney		20	30.97		08	05.19	do	Do.
Rowe		55	30.09		34	04.47	do	Do.
St. Bernard		55	03.43		34	09.18	do	Do.
St. Francis church		44	52.08		24	56.27	do	Do.
St. Francisville:								
Catholic church cross		46	26.82		23	25.55	do	Do.
Episcopal church		46	32.40		23	14.55	do	Do.
St. Gabriel church		15	19.86		06	24.33	do	Do.
St. Martin		09	15.71		02	03.15	do	Do.
St. Maurice		43	44.87		28	42.96	do	Do.
St. Peter's and St. Paul's church		30	16.74		15	11.93	do	Do.
Sandy Point		40	13.41		19	16.45	do	Do.
School		14	53.98		07	14.93	do	Do.
Schultz		47	12.33		33	36.52	do	Do.
Shaw		47	37.58		32	38.51	do	Do.
Shelton		41	32.96		20	30.05	do	Do.
Slaughter		39	56.26		17	23.56	do	Do.
Small house, chimney		18	48.66		09	19.62	do	Do.
Smith chimney		55	52.05		39	03.62	do	Do.
Smithland gin		55	44.87		39	06.17	do	Do.
Solitude		34	29.05		16	50.45	do	Do.
Southwood		13	26.81		03	04.90	do	Do.
Sugarhouse chimney		13	19.56		02	54.08	do	Do.
Souvenir, sugarhouse chimney		06	45.94		01	51.94	do	Do.
Springfield		33	54.83		15	02.51	do	Do.
Star, sugarhouse chimney		14	49.26		06	25.28	do	Do.
Stevenson		52	32.03		31	41.39	do	Do.
Stewart, sugarhouse chimney		43	43.50		31	55.75	do	Do.
Stump		53	59.06		32	25.84	do	Do.
Swamp		30	56.46		14	56.65	do	Do.
Taylor		43	39.89		21	33.21	do	Do.
Sugarhouse chimney		44	04.34		22	02.19	do	Do.
Thomas		32	31.95		15	36.48	do	Do.
Thompson		44	31.96		22	04.28	do	Do.
Tonliet, sugarhouse chimney		20	25.26		11	44.48	do	Do.
Tregars chimney		59	27.59		38	40.74	do	Do.
Tunica Island		49	18.49		31	14.57	do	Do.
Tunica Landing		55	15.19		33	01.72	do	Do.
Van Winkle		40	02.06		20	23.82	do	Do.
Van Winkle B. B		39	20.57		20	43.16	do	Do.
Ventress		16	50.81		08	24.25	do	Do.
Vignes		45	10.06		35	26.43	do	Do.
Sugarhouse chimney		42	25.00		21	25.10	do	Do.
Viola		31	02.33		13	10.14	do	Do.
Vohn's, sugarhouse chimney		24	20.19		13	35.33	do	Do.
Von Pool		29	25.04		12	02.07	do	Do.
Wade		52	39.77		31	13.56	do	Do.
House		52	57.11		31	19.58	do	Do.
Shed		52	27.49		31	07.38	do	Do.
Waterloo		41	18.99		20	57.75	do	Do.
Church		40	48.87		21	40.44	do	Do.
Sugarhouse chimney		12	42.28		01	19.16	do	Do.
Store		41	50.56		21	08.12	do	Do.
Wick's, sugarhouse chimney		25	32.16		11	03.26	do	Do.
Wild Wood		38	18.60		18	21.21	do	Do.
Sawmill		38	15.63		18	25.75	do	Do.
Willow Bar		45	20.07		25	21.34	do	Do.
Willow Glen		16	14.30		07	02.23	do	Do.
Winter		32	04.12		16	30.43	do	Do.
Sugarhouse chimney		36	43.60		19	02.95	do	Do.
Woodland		18	25.28		13	58.40	do	Do.
Woods		20	24.97		10	49.80	do	Do.
Woodstock, sugarhouse chimney		10	28.12		01	20.51	do	Do.
Woodyard		44	12.22		28	47.20	do	Do.
Yale, sugarhouse chimney		10	46.66		01	47.86	do	Do.
	29°-30°			90°-91°				
Caillon	29	05	41.59	90	31	41.30	C. & G. S	
Calumet		06	12.59		20	58.79	do	
George		06	33.82		15	09.27	do	
James		06	22.18		24	11.10	do	
Tape		08	43.01		31	33.49	do	
Terrebonne		06	30.08		28	19.86	do	
Timballier light-house (1887)		03	06.01		20	57.38	do	

TEXAS.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°-34°	99°-100°		
	° ′ ″	° ′ ″		
	33 09 31.57	99 43 54.96	G.S	Bull. 122.
	00 56.10	59 34.60	do	Do.
	3°3-34°	100°-101°		
	33 03 59.68	100 26 11.37	do	Do.
	32°-33°	96°-97°		
l	32 40 47.93	96 54 56.48	do	Do.
	51 44.85	46 23.42	do	Do.
	47 19.39	39 49.01	do	Do.
	32°-33°	97°-98°		
	32 55 12.22	97 16 38.17	do	Do.
	07 32.51	46 44.20	do	Do.
	15 11.92	16 57.74	do	Do.
	39 48.57	43 43.31	do	Do.
eak	29 00.39	24 27.05	do	Do.
le	36 32.51	12 07.25	do	Do.
he	22 38.19	47 59.00	do	Do.
	09 36.80	59 24.87	do	Do.
	53 44.08	06 34.46	do	Do.
od	06 04.59	40 45.05	do	Do.
s	10 16.44	14 28.25	do	Do.
n	48 18.01	53 38.28	do	Do.
	19 09.35	32 52.02	do	Do.
	03 43.68	20 01.32	do	Do.
	01 16.18	42 49.30	do	Do.
	53 50.54	42 36.74	do	Do.
	09 10.70	51 03.25	do	Do.
	20 07.12	36 41.29	do	Do.
	43 17.38	07 59.43	do	Do.
r	41 45.52	16 30.30	do	Do.
ake	48 05.84	38 32.84	do	Do.
n	56 44.38	54 39.80	do	Do.
	09 58.97	05 58.61	do	Do.
	26 17.43	01 24.99	do	Do.
	32°-33°	98°-99°		
ack	32 57 15.29	98 51 18.72	do	Do.
	55 35.49	18 02.09	do	Do.
	54 29.77	30 09.01	do	Do.
ridge	48 03.95	49 51.89	do	Do.
	22 04.81	56 19.87	do	Do.
onomical pier	23 31.45	58 55.56	do	Do.
d	39 12.25	41 26.88	do	Do.
	43 47.07	17 52.54	do	Do.
Mountain	35 06.69	55 05.25	do	Do.
	19 19.02	22 38.75	do	Do.
	41 51.43	27 25.52	do	Do.
	17 40.67	29 27.79	do	Do.
	49 24.60	19 08.23	do	Do.
	02 41.87	54 53.40	do	Do.
y	27 09.30	11 22.81	do	Do.
el	17 09.56	49 47.97	do	Do.
	18 32.64	13 19.65	do	Do.
	12 58.07	21 36.91	do	Do.
n	40 59.96	35 53.02	do	Do.
	32°-33°	99°-100°		
	32 26 51.39	99 44 39.80	do	Do.
	45 29.54	53 43.33	do	Do.
	19 07.47	52 08.98	do	Do.
	36 00.71	29 11.90	do	Do.
ood	13 41.10	09 10.76	do	Do.
	10 21.65	49 45.86	do	Do.
se	39 17.06	11 56.21	do	Do.
	51 20.75	05 39.68	do	Do.
	28 42.69	18 50.74	do	Do.
	59 33.38	10 19.31	do	Do.
	12 01.65	56 43.69	do	Do.
	44 20.15	18 48.62	do	Do.
	15 26.24	40 48.20	do	Do.
	50 51.24	24 09.62	do	Do.
	47 28.06	12 14.84	do	Do.
	42 15.90	52 40.50	do	Do.
	42 44.26	25 11.16	do	Do.
ap	01 23.63	46 54.52	do	Do.
la	58 20.32	34 21.57	do	Do.
	27 43.99	01 26.22	do	Do.
	32°-33°	100°-101°		
	32 43 49.63	100 06 19.79	do	Do.
	00 40.36	27 34.69	do	Do.
	19 55.64	16 37.66	do	Do.

TEXAS—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	32°-33°	100°-101°		
	° ′ ″	° ′ ″		
Fence	32 26 40.88	100 14 30.05	G. S	Bull. 122.
Flint	07 48.41	02 41.19	do	Do.
Goat	00 56.09	36 27.63	do	Do.
Rusticus	12 39.04	15 12.15	do	Do.
Sweetwater	28 31.23	24 24.09	do	Do.
Sykes	17 29.43	23 42.72	do	Do.
Wasp	34 11.27	26 36.03	do	Do.
Jacksonville:	31°-32°	95°-96°		
Astronomical station	31 57 49.70	95 16 16.80	C. & G. S	
Methodist spire	57 37.91	16 20.08	do	
Presbyterian spire	57 40.47	16 07.57	do	
	31°-32°	97°-98°		
Adams	31 53 31.39	97 43 23.58	G. S	Do.
Doty	56 23.59	51 41.64	do	Do.
Frazier	59 31.22	04 44.75	do	Do.
Ghent	19 18.01	19 08.22	do	Do.
Kellum	48 45.07	27 16.61	do	Do.
Kendrick	29 37.62	14 18.50	do	Do.
Lynch	12 29.66	20 19.08	do	Do.
Mount Taylor	04 54.52	57 45.14	do	Do.
Nick	43 19.10	28 53.50	do	Do.
Simpson	36 08.95	29 26.69	do	Do.
West	48 22.07	05 47.56	do	Do.
Wind Mill	26 01.94	30 02.20	do	Do.
	31°-32°	98°-99°		
Station D	31 04 09.80	98 39 45.30	do	Do.
Thompson	55 13.70	53 40.90	do	Do.
Waters Mountain	05 31.20	20 27.60	do	Do.
	31°-32°	99°-100°		
Ballinger	31 44 24.92	99 56 40.24	do	Do.
Bones	00 31.31	39 17.61	do	Do.
Bradley	48 43.66	41 25.84	do	Do.
Live Oak	17 15.82	39 28.17	do	Do.
Maddox	04 19.66	46 12.14	do	Do.
Molloy	17 20.35	51 21.63	do	Do.
Mustang	02 34.52	56 00.35	do	Do.
Plateau	37 41.66	55 39.75	do	Do.
Rough	55 20.70	36 44.93	do	Do.
	31°-32°	100°-101°		
Ashurst	31 48 42.42	100 40 01.30	do	Do.
Bolt	08 19.11	50 47.98	do	Do.
Cedar	45 18.85	19 36.94	do	Do.
Concho	47 19.71	49 10.33	do	Do.
Dove	11 49.51	37 38.05	do	Do.
Dry	34 21.54	53 50.27	do	Do.
Edith	53 37.40	39 52.57	do	Do.
Flower	05 35.80	05 09.43	do	Do.
Funk	31 20.22	48 47.32	do	Do.
Gunny	30 03.10	38 58.62	do	Do.
Hayrick	59 29.96	20 48.70	do	Do.
Keith	11 54.22	13 44.55	do	Do.
Lake	52 13.50	46 01.34	do	Do.
Lipan	14 17.14	19 20.68	do	Do.
Lopez	20 40.27	51 04.44	do	Do.
Napp	46 37.47	43 00.86	do	Do.
Robert Lee	53 39.29	29 03.87	do	Do.
San Angelo	27 51.31	26 16.06	do	Do.
Water Valley	37 47.51	45 15.85	do	Do.
	31°-32°	104°-105°		
Diablo	31 11 50.54	104 54 52.40	do	Do.
El Capitan	53 26.38	51 39.69	do	Do.
	31°-32°	105°-106°		
Arispe	31 09 11.33	105 17 00.09	do	Bull. 70.
Cerro Alto	56 39.90	58 15.05	do	Bull. 122.
East base	04 54.70	09 32.38	do	Bull. 70.
Mesa	07 16.43	09 12.38	do	Do.
Quitman	08 56.68	29 48.26	do	Bull. 122.
Salt	34 40.74	08 51.69	do	Do.
Sierra Blanca	15 05.34	26 09.64	do	Do.
Astronomical pier	10 27.64	21 24.96	do	Bull. 70.
Taff	12 28.86	17 25.68	do	Do.
West base	06 35.65	13 03.41	do	Do.
Yucca	06 40.08	20 51.72	do	Do.
	31°-32°	106°-107°		
El Paso, Fort Bliss, astronomical monument.	31 45 31.00	106 29 05.00	Wheeler	Rept. '79.
Graveyard Hill	45 52.00	29 41.00	do	Do.

TEXAS—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	31°-32°	**106°-107°**		
	° ′ ″	° ′ ″		
ranklin	31 54 07.24	106 29 35.83	G. S	Bull. 122.
ranklin Mountain	48 15.00	28 47.00	Wheeler	Rept. '79.
	30°-31°	**97°-98°**		
ob	30 20 05.87	97 35 23.54	G. S	Bull. 122.
Hill	07 38.30	18 35.30	do	Do.
Hill	42 25.88	33 52.51	do	Do.
ill	11 21.78	57 08.14	do	Do.
ll	47 16.37	37 15.18	do	Do.
atlif	53 41.15	43 52.40	do	Do.
k	35 02.56	41 00.60	do	Do.
	11 48.34	36 32.72	do	Do.
ice	16 19.93	44 13.02	do	Do.
ee, 1	19 17.54	48 29.95	do	Do.
n Ridge	45 19.74	50 42.37	do	Do.
ob	09 29.83	42 20.80	do	Do.
	27 15.59	42 07.64	do	Do.
2	51 14.17	57 33.71	do	Do.
ill	08 35.36	32 09.60	do	Do.
se	12 15.17	42 56.82	do	Do.
nob	20 31.99	11 20.30	do	Do.
	30°-31°	**98°-99°**		
r Peak	30 59 39.33	98 05 42.00	do	Do.
ntain	26 47.45	43 00.12	do	Do.
house	33 37.40	05 19.93	do	Do.
Hill	56 22.45	17 33.60	do	Do.
ountain	35 33.74	55 08.09	do	Do.
n	04 35.92	05 11.12	do	Do.
untain	53 52.98	20 09.43	do	Do.
untain	40 07.12	36 18.32	do	Do.
ill	46 17.52	16 11.78	do	Do.
	27 11.52	21 57.88	do	Do.
	18 12.80	05 38.58	do	Do.
	26 30.19	14 46.10	do	Do.
B	54 38.67	52 43.77	do	Do.
E	13 40.14	26 32.70	do	Do.
	30°-31°	**100°-101°**		
	30 49 00.64	100 18 24.99	do	Do.
	47 08.23	04 54.00	do	Do.
	48 55.20	55 40.13	do	Do.
	39 40.12	07 33.92	do	Do.
	43 24.69	58 22.66	do	Do.
	18 24.18	17 28.67	do	Do.
	05 08.67	15 50.98	do	Do.
	54 07.25	05 59.39	do	Do.
Kavett	49 44.07	06 30.69	do	Do.
	10 05.90	10 47.16	do	Do.
	00 26.69	14 16.28	do	Do.
	21 42.64	12 06.09	do	Do.
n	25 35.59	02 23.80	do	Do.
	45 21.64	41 42.07	do	Do.
	32 52.64	12 28.28	do	Do.
	38 41.06	14 59.28	do	Do.
	51 35.49	46 26.47	do	Do.
	43 14.84	48 53.68	do	Do.
	16 00.33	27 18.40	do	Do.
rth	26 34.59	20 38.55	do	Do.
	03 41.97	21 55.55	do	Do.
	30°-31°	**103°-104°**		
rd	30 14 23.04	103 30 56.05	do	Do.
	46 36.32	47 40.23	do	Do.
	30°-31°	**104°-105°**		
	30 38 05.85	104 10 26.27	do	Do.
	48 07.73	42 36.10	do	Do.
signal	59 51.56	59 56.49	do	Bull. 70.
	59 58.36	04 45.31	do	Bull. 122.
	27 07.33	40 42.70	do	Do.
	30°-31°	**105°-106°**		
	30 55 14.41	105 05 08.13	do	Do.
	29°-30°	**98°-99°**		
ters	29 58 48.70	98 26 40.50	do	Do.
	29°-30°	**100°-101°**		
o	29 11 12.82	100 17 10.78	do	Do.
	12 07.36	08 28.00	do	Do.
	46 21.43	28 11.65	do	Do.
rk	18 27.65	25 08.14	do	Do.
	44 56.80	17 24.28	do	Do.
	54 15.25	19 01.08	do	Do.

TEXAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	29°-30°			100°-101°				
	°	′	″	°	′	″		
Las Moras	29	21	31.62	100	23	13.43	G. S	Bull. 122.
Monte		33	46.53		12	02.84	do	Do.
Nueces		37	33.84		19	51.26	do	Do.
Reagan		44	56.45		11	27.54	do	Do.
Spofford, water tank		10	31.91		24	32.72	do	Do.
Turkey		22	30.25		11	55.82	do	Do.
	29°-30°			103°-104°				
San Jacinto	29	45	12.59	103	57	19.11	do	Do.
Santiago		50	04.66		24	59.26	do	Do.
	29°-30°			104°-105°				
Chinati	29	57	09.32	104	28	41.05	do	Do.

ARKANSAS.

	36°-37°			91°-92°				
	°	′	″	°	′	″		
Salem	36	22	33.15	91	51	51.75	G. S	Bull. 122.
	36°-37°			92°-93°				
Alpha	36	13	01.65	92	06	48.75	do	Do.
Matny		12	18.70		18	57.43	do	Do.
Pilot		05	33.37		01	19.18	do	Do.
Pine, 2		24	47.43		40	42.55	do	Do.
Wallace Knob		21	23.63		22	37.71	do	Do.
	36°-37°			93°-94°				
Boat	36	07	33.17	93	02	09.29	do	Do.
Bread		34	45.63		28	47.28	do	Do.
Kennedy		14	24.06		13	31.11	do	Do.
Lead		25	50.96		00	52.38	do	Do.
Pyron		23	35.29		32	08.61	do	Do.
Sugar		27	36.37		53	48.00	do	Do.
Swain		17	23.38		45	52.65	do	Do.
Watson		15	00.09		28	21.56	do	Do.
	36°-37°			94°-95°				
Kestler	36	01	00.91	94	13	11.84	do	Do.
Orchard		09	59.74		04	32.59	do	Do.
Rogers		19	53.30		06	43.29	do	Do.
Twin		08	42.54		22	42.02	do	Do.
	35°-36°			90°-91°				
Appersen	35	06	51.50	90	10	07.14	Miss. R. C	Rept. '88.
Collins		01	32.71		17	33.87	do	Do.
East base		08	26.40		09	11.98	do	Do.
Fleece		03	11.19		10	11.52	do	Do.
Harris		02	13.13		12	47.81	do	Do.
Jones		05	25.92		10	33.06	do	Do.
Mathews		04	00.11		10	51.94	do	Do.
Mound City		10	39.88		06	29.73	do	Do.
Reeves		03	04.37		11	35.77	do	Do.
Scanlon		02	08.14		16	14.26	do	Do.
West base		08	09.59		10	36.53	do	Do.
	35°-36°			91°-92°				
Cedar	35	56	30.75	91	49	24.90	G. S	Bull. 122.
Deane		44	34.43		44	24.55	do	Do.
Mount Etna		52	32.89		45	07.36	do	Do.
	35°-36°			92°-93°				
Black	35	32	43.48	92	40	47.05	do	Do.
Blue		52	14.86		21	51.18	do	Do.
Brush		49	03.11		36	52.05	do	Do.
Burrow		09	31.11		43	28.65	do	Do.
Cox		03	50.10		14	56.57	do	Do.
Evans		29	25.31		51	19.02	do	Do.
Finch		46	32.23		10	42.94	do	Do.
Fourche		01	01.68		50	55.13	do	Do.
Hump		20	23.13		13	17.40	do	Do.
Irons Point		51	30.69		01	04.50	do	Do.
Pig		17	40.98		32	22.09	do	Do.
Pine Hill		38	06.80		41	20.52	do	Do.
Point Pisgah		07	29.37		29	16.62	do	Do.
Pond		41	32.08		11	27.52	do	Do.
Raspberry		39	42.89		57	49.34	do	Do.
Red Hill		43	30.27		30	59.57	do	Do.
Reeves		43	31.74		44	17.74	do	Do.
Round, 2		50	26.51		56	23.41	do	Do.
Walker		40	13.08		51	46.06	do	Do.
Walnut		39	08.44		30	30.08	do	Do

ARKANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	35°-36°			93°-94°				
	°	′	″	°	′	″		
Hill	35	03	10.25	93	19	48.41	G. S	Bull. 122.
		54	04.07		59	28.90	do	Do.
e		09	57.68		38	41.72	do	Do.
		12	42.00		19	36.80	do	Do.
	35°-36°			94°-95°				
	35	47	37.74	94	10	03.95	do	Do.
l		54	32.67		27	53.07	do	Do.
t		42	00.22		08	46.89	do	Do.
		57	41.53		31	16.56	do	Do.
ith		23	14.65		25	52.35	do	Do.
		37	42.12		21	58.45	do	Do.
		39	37.70		15	09.63	do	Do.
		04	22.98		22	22.85	do	Do.
		12	45.51		03	12.44	do	Do.
		50	02.13		32	30.28	do	Do.
		51	26.29		09	14.99	do	Do.
r		47	44.26		20	16.53	do	Do.
ld		44	14.02		02	28.69	do	Do.
	34°-35°			90°-91°				
	34	22	41.73	90	41	46.12	do	Do.
		34	13.68		33	56.61	Miss. R. C	
n		19	22.63		44	32.04	G. S	Do.
		12	51.70		54	08.13	do	Do.
e		20	12.28		44	57.00	do	Do.
		45	48.88		26	53.09	Miss. R. C	Rept. '87.
		47	08.52		27	26.50	do	Do.
		51	10.55		23	54.75	do	Do.
oint		05	30.72		55	07.37	do	Rept. '82.
		39	30.58		30	51.23	do	Rept. '87.
nt		50	19.13		25	45.71	do	Do.
k		01	34.13		03	23.82	do	Rept. '82.
x Island		45	48.85		30	22.77	do	Rept. '87.
t		35	32.69		33	15.48	do	Rept. '82.
t		03	12.58		54	13.97	do	Do.
		23	17.62		43	15.05	do	Do.
nd		55	31.59		15	55.39	do	Rept. '87.
e		57	17.51		16	04.78	do	Do.
		45	09.20		27	39.33	do	Do.
		24	19.19		37	30.66	do	Rept. '82.
70		00	44.10		57	52.10	do	Do.
nding		15	05.59		53	45.14	do	Do.
r		59	11.84		17	37.76	do	Rept. '87.
Chute		44	56.19		31	12.88	do	Do.
ny		23	21.61		38	22.27	do	Rept. '82.
		07	29.61		56	53.18	do	Do.
		13	39.39		55	28.03	do	Do.
		01	05.73		02	09.50	do	Do.
		51	35.65		20	20.91	do	Rept. '87.
ck		02	44.85		55	39.03	do	Rept. '82.
Point		40	13.21		29	11.78	do	Rept. '87.
		31	08.06		35	15.09	do	Rept. '82.
sland No. 2		34	40.65		32	21.91	do	Do.
		36	31.37		35	10.09	do	Rept. '87.
		16	09.25		48	57.54	do	Rept. '82.
2		18	09.59		45	22.33	do	Do.
3		17	30.48		45	39.10	do	Do.
7		08	56.54		57	11.68	do	Do.
3		08	30.47		56	30.04	do	Do.
		11	10.44		52	52.80	do	Do.
		40	25.02		33	30.04	do	Rept. '88.
o Point		22	16.17		40	17.72	do	Rept. '82.
n		09	50.51		54	09.39	do	Do.
		02	20.86		56	25.74	do	Do.
		38	50.76		35	08.41	do	Rept. '88.
		11	32.62		54	28.03	do	Rept. '82.
		14	49.02		50	09.87	do	Do.
		06	29.50		56	13.29	do	Do.
k		09	16.51		52	12.17	do	Do.
		17	28.13		47	52.86	do	Do.
m		20	53.26		45	20.01	do	Do.
ell		57	58.73		16	28.55	do	Rept. '88.
		09	28.04		50	58.24	do	Rept. '82.
t		17	48.95		46	35.64	do	Do.
		48	47.25		27	42.03	do	Rept. '88.
ake		52	08.18		19	17.04	do	Do.
		35	37.18		34	04.13	do	Do.
		21	50.94		45	18.85	do	Rept. '82.
		27	29.65		34	52.57	do	Do.
		43	45.82		31	50.45	do	Rept. '88.

ARKANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	34°-35°			90°-91°				
	°	′	″	°	′	″		
St. Francis	34	40	00.08	90	31	43.83	Miss. R. C	Rept. '88.
St. Louis Landing		11	18.35		51	49.86	do	Rept. '82.
Sterling		37	27.75		35	34.87	do	Rept. '88.
Tow Head		17	59.77		44	19.60	do	Rept. '82.
West base		39	10.54		32	25.40	do	Rept. '88.
Westover		22	55.12		39	15.24	do	Rept. '82.
Walnut Bend		42	52.44		31	23.23	do	Rept. '88.
Wardell		39	24.73		28	59.63	do	Do.
Warfield		01	52.15		57	09.66	do	Rept. '82.
Williamson		29	32.37		35	27.48	do	Do
Zenor		09	54.94		56	19.41	do	Do.
	34°-35°			91°-92°				
Foot of 70	34	00	10.06	91	00	49.71	do	Do.
Henley		00	44.49		04	41.86	do	Do.
Scrub Grass		00	17.90		03	46.25	do	Do.
	34°-35°			92°-93°				
Big Rock	34	46	17.88	92	17	55.49	G. S	Bull. 122.
Blocher		40	12.75		50	32.26	do	Do.
East base		44	09.15		10	24.73	do	Do.
Granite		41	11.10		17	30.50	do	Do.
Maumelle		50	25.22		29	09.79	do	Do.
Moss Mountain		49	53.56		40	13.42	do	Do.
Post-office		44	47.83		16	25.36	do	Do.
Reynolds		58	28.95		28	17.66	do	Do.
Shinall		47	51.69		29	49.62	do	Do.
West base		45	19.09		13	33.32	do	Do.
Warsaw		56	33.48		08	52.12	do	Do.
	34°-35°			93°-94°				
Allen	34	51	06.10	93	28	14.79	do	Do.
Muddy		46	06.63		31	57.82	do	Do.
Powell		46	01.91		20	45.57	do	Do.
Round		44	00.72		44	55.63	do	Do.
Smith		46	11.34		01	49.01	do	Do.
Whiteoak		58	41.14		56	41.10	do	Do.
	34°-35°			94°-95°				
Black Fork	34	42	39.78	94	22	05.39	do	Do.
Blue		41	07.21		02	53.18	do	Do.
East Poteau		58	32.51		09	30.16	do	Do.
Poteau, 2		57	42.39		22	31.33	do	Do.
	33°-34°			91°-92°				
Adams	33	12	35.70	91	06	03.33	Miss. R. C	Rept. '88.
Arkansas River		48	41.21		04	22.02	do	Rept. '82.
Arkansas City		36	06.49		12	31.35	do	Do.
Bachelors Bend, tow-head		23	35.23		05	34.93	do	Rept. '88.
Barnard		05	54.40		10	35.21	do	Do.
Betsley		59	01.89		04	09.20	do	Rept. '82.
Bradley		57	22.66		03	09.49	do	Do.
Brooks		09	09.00		09	28.35	do	Rept. '88.
Cane		43	35.28		10	56.80	do	Rept. '82.
Cassell		59	49.91		04	52.14	do	Do.
Catfish Tow-head		40	41.36		08	30.06	do	Do.
Chicora		40	28.00		12	24.65	do	Do.
Chicot		38	55.47		10	58.84	do	Do.
Cook		40	25.69		05	04.81	do	Do.
Coryes		42	27.28		04	45.30	do	Do.
Cracraft's gin, southeast gable		03	50.50		09	45.19	do	Do.
Cumbyville		54	07.09		03	57.62	do	Do.
Cypress Creek		43	13.16		11	48.85	do	Do.
Davis		18	55.89		11	00.65	do	Do.
Deadwood		43	12.05		06	55.94	do	Do.
Drift		10	27.90		05	26.45	do	Rept. '88.
Duffin		35	24.94		13	20.47	do	Rept. '82.
Eunic		32	23.38		12	45.58	do	Do.
Frank, J		53	14.11		03	52.27	do	Do.
Ford		08	49.85		07	53.74	do	Rept. '88.
Gaines Landing		27	51.90		14	28.68	do	Rept. '82.
Good Luck		43	10.75		09	31.84	do	Do.
Goose Bar		15	21.19		07	40.25	do	Rept. '88.
Graves		00	58.81		09	53.22	do	Do.
Store, northeast chimney		02	16.91		09	42.48	do	Do.
Haley		08	25.73		11	08.73	do	Do.
Halliday		22	26.22		07	48.58	do	Do.
Harwood		09	18.91		06	37.96	do	Do.
Harwood's store, chimney		09	39.42		06	11.70	do	Do.
Harwood, white house, southeast chimney.		09	40.42		06	28.32	do	Do.
Hawkins		09	48.23		06	05.91	do	Do.
Hayden		42	42.45		05	53.93	do	Rept. '82.
Hill's chimney		07	49.20		08	44.99	do	Rept. '88.

ARKANSAS—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°-34°	91°-92°		
	° ′ ″	° ′ ″		
Hilliard	33 04 54.70	91 10 05.42	Miss. R. C.	Rept. '88.
Hilliard's pigeon house	04 50.91	10 06.37	do	Do.
Hilliard's store chimney	04 52.10	10 06.00	do	Do.
Hunting Lodge	03 15.94	09 48.94	do	Do.
Island 78	36 46.27	09 44.39	do	Rept. '82.
Island 83	25 20.40	03 58.47	do	Do.
Jersey Point	40 57.39	07 15.36	do	Do.
Junction	13 20.01	07 00.70	do	Rept. '88.
Lakeport	13 37.43	07 31.09	do	Do.
Lands End	59 15.90	00 17.07	do	Rept. '82.
Leland	21 41.85	09 09.44	do	Do.
Longwood:				
Gin chimney	09 26.64	04 37.49	do	Rept. '88.
Warehouse gable	09 15.33	05 18.64	do	Do.
Marengo, gin chimney	05 54.88	11 29.23	do	Do.
Middle Ground	50 05.95	03 28.32	do	Rept. '82.
Melona	51 29.22	03 07.89	do	Do.
Mitchell	39 41.03	11 46.10	do	Do.
Montgomery	58 06.02	03 32.66	do	Do.
Moore	07 32.10	11 51.06	do	Rept. '88.
Mud Creek	28 38.13	14 17.93	do	Rept. '82.
Napoleon	47 45.35	04 33.45	do	Do.
North Choctaw	38 20.50	00 56.12	do	Do.
Oak Landing	44 08.01	08 29.53	do	Do.
Old Town	22 55.91	44 25.92	do	Do.
Ozart	45 56.60	06 32.98	do	Do.
Palmetto	33 16.62	13 24.13	do	Do.
Panther Forest	26 47.53	12 28.68	do	Do.
Point Chicot	24 44.14	05 24.84	do	Rept. '88.
Tow Head	26 04.00	05 06.98	do	Rept. '82.
Point Comfort	28 40.47	10 40.46	do	Do.
Point Cook	41 29.00	03 53.80	do	Do.
Raft	11 42.42	05 34.81	do	Rept. '88.
Raynor	03 59.84	09 34.36	do	Do.
Rowdy Bend	26 50.95	13 41.37	do	Rept. '82.
Russett	42 00.01	02 53.33	do	Do.
Sabenden	41 20.95	12 38.08	do	Do.
Sibley	56 25.35	03 00.68	do	Do.
Scott	27 29.08	11 23.08	do	Do.
South Choctaw	37 21.02	09 19.52	do	Do.
Starling	16 46.24	08 29.68	do	Rept. '88.
Sterling	02 02.89	09 36.32	do	Do.
Stevenson	00 09.42	11 05.68	do	Do.
Sunnyside	17 31.73	09 22.35	do	Do.
Thorn Point	46 38.45	05 20.47	do	Rept. '82.
Turner	40 17.03	06 17.35	do	Do.
Vancluse	20 27.64	10 32.78	do	Rept. '88.
Wallwood	25 37.56	06 35.10	do	Rept. '82.
Warner	28 37.54	08 04.30	do	Do.
White Hill	36 24.25	11 19.67	do	Do.
White River	55 31.36	03 19.12	do	Do.
Whittaker	22 57.68	06 47.74	do	Rept. '88.
Wilkinson	42 09.15	08 10.34	do	Rept. '82.
Williams	45 15.51	08 37.61	do	Do.
Yellow Bend	34 16.41	13 46.24	do	Do.

INDIAN TERRITORY.

	35°-36°	94°-95°		
	° ′ ″	° ′ ″		
Cavanal	35 04 11.43	94 40 46.16	G. S.	Bull. 122.
North base	07 59.47	32 01.38	do	Do.
Poteau, 1	55 24.14	29 28.19	do	Do.
South base	05 47.52	33 23.98	do	Do.
Sugarloaf	01 31.49	28 07.04	do	Do.

TENNESSEE.

	36°-37°	82°-83°		
	° ′ ″	° ′ ″		
Bristol	36 35 49.00	82 11 13.00	C. & G. S.	Bull. 122.
Chimney Top	24 28.90	42 24.20	G. S.	
Holston	27 27.30	04 38.50	do	Do.
Roan	06 16.40	07 20.60	do	Do.

TENNESSEE—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	36°-37°			83°-84°				
	°	′	″	°	′	″		
House	36	06	42.90	83	45	59.90	G. S	Bull. 122.
McLean		28	19.80		55	47.50	do	Do.
Short		22	52.60		10	45.80	do	Do.
War Gap		30	14.70		01	38.00	do	Do.
	36°-37°			84°-85°				
Adkins	36	09	42.75	84	51	52.98	C. & G. S	
Brushy		04	37.22		24	37.75	do	
Cross		11	55.20		13	52.30	do	Do.
Jellico		35	03.20		07	28.80	do	
	36°-37°			85°-86°				
Apple	36	10	48.51	85	48	09.98	do	
Walker		10	26.85		20	36.63	do	
	35°-36°			82°-83°				
Chucky	35	59	39.50	82	53	42.30	G. S	Do.
	35°-36°			83°-84°				
Chilhowee, 1	35	45	54.50	83	45	30.10	do	Do.
English		54	04.90		17	51.50	C. & G. S	Do.
	35°-36°			84°-85°				
Hangover	35	23	11.70	84	58	08.16	do	
Chilhowee, 2		35	46.90		00	28.00	G. S	Do.
Chilhowee, 4		07	24.70		37	16.20	do	Do.
Guide		26	25.80		14	03.60	do	Do.
Hinch		46	53.10		58	42.80	do	Do.
Luper		57	16.39		47	20.17	do	
Melton		54	34.80		18	18.40	do	Do.
Owen		36	34.00		29	38.84	do	
Roy		31	27.60		26	46.30	G. S	Do.
Texas		19	31.70		54	38.40	do	Do.
	35°-36°			85°-86°				
Cardwell	35	40	59.82	85	40	47.61	C. & G. S	
Grindstone		04	18.00		01	18.60	G. S	Do.
Harvey		23	33.10		17	44.90	do	Do.
Mount Love		54	57.71		32	26.12	C. & G. S	
Short		52	14.78		58	22.44	do	Do.
	35°-36°			86°-87°				
Bennett	35	55	57.47	86	37	11.08	do	
Versailles		43	11.94		32	22.52	do	
	35°-36°			90°-91°				
Barton	35	12	16.53	90	06	03.23	Miss. R. C	Rept. '87.
Bayou		08	05.49		07	38.44	do	Do.
Cow Island		00	19.18		16	57.76	do	Do.
Bend		00	12.26		17	56.78	do	Do.
Crawford		06	54.00		08	23.68	do	Do.
Davis		07	05.13		06	46.91	do	Do.
Ensley		04	10.88		09	39.29	do	Do.
Forrest		06	41.10		05	20.36	do	Do.
Frame Chute		10	57.76		04	14.43	do	Do.
Hopefield		09	54.93		04	27.02	do	Do.
Horn Lake		01	19.59		12	30.17	do	Do.
Lake		07	41.73		09	18.49	do	Do.
Leadbetter		06	08.40		09	31.28	do	Do.
Memphis		08	39.00		03	15.45	C. & G. S	Rept. '84.
Do		08	39.85		03	20.22	Miss. R. C	Rept. '87.
Do		08	38.60		03	16.50	L. S	Final Re
Do		08	37.50		03	17.40	do	Do.
Patterson		02	09.75		13	52.91	Miss. R. C	Rept. '87.
Peterson		07	46.06		04	15.11	do	Do.
Rock Chute		01	29.67		13	52.91	do	Do.
Vance, jr		07	39.56		05	37.57	do	Do.
Vance, sr		08	30.58		04	26.90	do	Do.
Wolf River		10	06.18		03	19.66	do	Do.
Watson		01	54.65		11	17.84	do	Do.

KENTUCKY.

	38°-39°			82°-83°				
	°	′	″	°	′	″		
Howland	38	37	47.18	82	59	20.14	C. & G. S	Rept. '84.
Louisa transit		06	54.90		36	06.15	do	Do.
Buena Vista		23	44.10		48	21.47	do	
Oakland		21	46.55		38	52.70	do	
	38°-39°			83°-84°				
Cave	38	32	39.81	83	04	23.42	do	
Mount Sterling		03	28.40		55	50.90	G. S	Bull. 122.

KENTUCKY—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	38°-39°	84°-85°		
	° ′ ″	° ′ ″		
h	38 40 37.60	84 16 54.20	C. & G. S	
n College building	02 25.30	30 21.00	do	
	38°-39°	85°-86°		
b	38 09 25.40	85 46 15.80	do	
e	15 08.00	45 28.80	do	
lle	12 45.40	13 14.60	do	
	37°-38°	82°-83°		
	37 24 02.90	82 40 05.60	G. S	Bull. 122.
	46 57.30	55 11.60	do	Do.
ıd	29 03.30	55 46.20	do	Do.
	06 44.80	43 54.00	do	Do.
	15 35.30	22 59.90	do	Do.
	43 34.40	34 20.90	do	Do.
	37°-38°	83°-84°		
	37 55 18.40	83 42 23.10	do	Do.
	14 29.20	05 33.50	do	Do.
	55 56.20	43 43.90	do	Do.
	37 26.90	18 51.00	do	Do.
	30 31.10	35 32.40	do	Do.
ːks	47 22.30	46 36.70	do	Do.
	23 10.00	46 20.60	do	Do.
ɔb	14 57.60	53 49.70	do	Do.
	37 01.90	04 28.30	do	Do.
	27 49.50	24 58.00	do	Do.
	43 13.40	31 05.10	do	Do.
	08 35.20	44 05.80	do	Do.
	12 53.80	50 05.60	do	Do.
	09 04.30	59 29.60	do	Do.
	22 14.30	35 33.90	do	Do.
	27 39.70	33 16.30	do	Do.
	27 16.30	44 26.80	do	Do.
ıby	55 39.80	53 07.60	do	Do.
	37°-38°	84°-85°		
	37 32 08.90	84 15 21.30	do	Do.
	20 04.50	25 51.20	do	Do.
ver	09 14.90	50 42.50	do	Do.
r	37 10.50	34 43.30	do	Do.
	08 02.20	05 20.14	C. & G. S	Rept. '84.
d	44 30.40	18 02.64	G. S	Bull. 122.
·al College	44 32.80	18 02.00	C. & G. S	
	31 12.40	52 08.90	G. S	Do.
ırry	37 56.20	02 33.10	do	Do.
	37°-38°	85°-86°		
ırg	37 15 38.30	85 29 56.40	C. & G. S	
	37°-38°	86°-87°		
	37 02 27.50	86 15 18.30	do	Rept. '84.
	37°-38°	87°-88°		
ɔn	37 50 24.80	87 35 26.10	do	Do.
	37°-38°	88°-89°		
	37 04 59.20	88 35 56.10	do	Do.
	36°-37°	83°-84°		
ob	36 47 16.20	83 17 26.40	G. S	Bull. 122.
	53 54.70	19 03.10	do	Do.
r	56 22.40	02 30.50	do	Do.
p	57 16.50	36 31.80	do	Do.
ocks	39 54.70	27 03.30	do	Do.
	36°-37°	84°-85°		
	36 50 59.90	84 05 34.40	do	Do.
	36°-37°	87°-88°		
	36 38 53.90	87 09 36.15	C. & G. S	
	36°-37°	89°-90°		
ı	36 34 17.70	89 11 41.35	do	Rept. '84.

OHIO.

	41°-42°	80°-81°		
	° ′ ″	° ′ ″		
:	41 37 05.72	80 36 30.62	L. S	Final Rept.
ıla:				
ːist church	52 02.70	47 01.60	do	Do.
ːhwest corner passenger depot	52 36.13	47 38.55	do	Do.

OHIO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	80°-81°		
	° ′ ″	° ′ ″		
Conneaut	41 53 52.58	80 36 51.56	C. & G. S	Final Rept.
Geneva	51 14.20	59 47.00	do	Do.
Saybrook	53 33.00	49 55.00	do	Do.
Mesopotamia	26 59.98	59 54.09	do	Do.
Berea:	41°-42°	81°-82°		
German Wallace College chapel spire.	41 22 06.10	81 51 06.30	do	Do.
Stone Methodist church spire	21 46.70	51 12.50	do	Do.
Chester	32 02.88	21 17.20	do	Do.
Claridon	30 39.61	07 06.27	do	Do.
Cleveland:				
Light-house on high bank in city	30 06.13	42 13.20	do	Do.
Light-house	30 01.60	42 09.60	do	Do.
Euclid	35 37.30	33 05.20	do	Do.
Fairport:				
Light-house on bank	45 24.80	16 39.70	do	Do.
Light-house on pier	45 41.60	16 48.80	do	Do.
Grafton	12 44.21	59 37.85	do	Do.
Little Mountain	38 26.34	16 28.60	do	Do.
North Royalton:				
Stone Baptist church spire	18 53.60	44 10.70	do	Do.
Frame Methodist church, in northern part of town, spire.	19 29.20	44 10.40	do	Do.
Olmstead	22 52.18	57 22.96	do	Do.
Painesville:				
Episcopal church (spire) on west side of State street.	43 41.20	14 36.10	do	Do.
Spire brick Congregational church	43 26.00	14 44.30	do	Do.
Perry	48 04.70	08 55.60	do	Do.
Rockport	27 45.93	47 32.30	do	Do.
Royalton	19 29.89	44 10.65	do	Do.
Thompson	41 14.35	02 37.47	do	Do.
Warrensville	28 39.24	30 12.88	do	Do.
Willoughby	40 28.71	26 25.77	do	Do.
	41°-42°	82°-83°		
Black River light-house	41 28 23.90	82 11 08.30	do	Do.
Brownhelm	23 18.46	18 28.76	do	Do.
Camden	16 26.04	17 46.73	do	Do.
Cedar Point light-house	29 17.40	41 37.40	do	Do.
Danbury	31 11.94	50 20.30	do	Do.
East base	26 28.58	38 04.66	do	Do.
Elyria	24 55.41	08 44.06	do	Do.
Green Island light-house	38 43.90	52 04.10	do	Do.
Huron:				
Presbyterian church spire	23 42.60	33 21.00	do	Do.
Light-house	24 03.10	32 51.10	do	Do.
Kelley	36 17.77	41 45.29	do	Do.
Marblehead light-house	32 11.00	42 43.40	do	Do.
Middle base	41 47.87	47 15.12	do	Do.
Oberlin:				
Second Congregational church spire.	17 28.90	13 10.50	do	Do.
Pointed tower at Union School building, South Main street.	17 26.20	13 01.80	do	Do.
Point Pelee	48 50.72	41 02.55	do	Do.
Sandusky	24 34.43	45 02.76	do	Do.
Court-house	27 13.80	42 41.90	do	Do.
Townsend	15 43.48	29 00.63	do	Do.
Vermillion	25 12.70	21 59.40	do	Do.
West base	29 02.32	40 58.43	do	Do.
	41°-42°	83°-84°		
Cedar Point	41 42 37.77	83 20 06.66	do	Do.
Locust Point	36 54.83	06 21.38	do	Do.
Toledo:				
St. Mary's Catholic church spire	39 32.10	32 02.50	do	Do.
Astronomical station, 182 west and 188 north of stone marking intersection of Ontario and Monroe streets; stone, long post, of 1881.	39 03.65	32 30.60	do	Do.
Turtle Island light-house	45 08.80	23 28.80	do	Do.
West Sister Island light-house	44 13.10	06 39.00	do	Do.
	39°-40°	82°-83°		
Columbus, transit	39 57 40.00	82 59 42.15	C. & G. S	Rept. '84.
	39°-40°	84°-85°		
Cincinnati	39 08 20.00	84 25 20.49	do	Do.
Mitchell's observatory (abandoned).	05 54.00	29 45.75	do	Do.

OHIO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	38°-39°	82°-83°		
	° ′ ″	° ′ ″		
	38 35 47.00	82 33 05.85	C. & G. S	Bull. 122.
	38 27.64	49 56.46	do	Do.
oint	25 14.00	35 26.00	do	Do.
	35 42.32	27 38.71	do	Do.

INDIANA.

	41°-42°	84°-85°		
	° ′ ″	° ′ ″		
;	41 42 32.09	84 57 58.97	L. S	Final Rept.
ner sec. 31, T. 38 N., R. 14 E	42 55.90	58 16.00	do	Do.
	41°-42°	85°-86°		
ecs. 2, 3, 10, 11, T. 37 N., R. 6 E	41 40 54.80	85 48 43.50	do	Do.
ı	41 00.04	48 30.08	do	Do.
ner NW. ¼ sec. 33, T. 38 N., R.	42 16.10	37 13.60	do	Do.
ecs. 4, 5, 8, 9, T. 37 N., R. 11 E	41 08.40	16 23.30	do	Do.
wer schoolhouse	43 30.70	25 13.60	do	Do.
	41 34.56	16 08.70	do	Do.
ren	42 29.79	36 46.74	do	Do.
	41°-42°	86°-87°		
	41 40 05.16	86 29 38.80	do	Do.
	41 45.88	40 32.13	do	Do.
ı City	44 07.79	52 20.79	do	Do.
. school spire	42 51.80	53 47.60	do	Do.
e Lutheran church	42 45.40	53 59.60	do	Do.
t-house	43 21.10	54 21.80	do	Do.
	35 18.65	52 35.94	do	Do.
	38 53.13	12 26.72	do	Do.
rlisle:				
e Christian church	42 22.30	30 41.90	do	Do.
e Methodist Episcopal church	42 25.70	30 40.80	do	Do.
end:				
dpipe	40 31.40	14 52.60	do	Do.
ersity dome	42 11.00	14 20.90	do	Do.
ille	39 52.80	44 30.61	do	Do.
ecs. 17, 18, 19, 20, T. 37 N., R. 3 E	39 04.40	12 57.30	do	Do.
ecs. 2, 3, 10, 11, T. 37 N., R. 1 W	40 46.40	30 23.60	do	Do.
ner SE. ¼ of SW. ¼ sec. 32, T. R. 2 W.	41 39.00	40 33.40	do	Do.
er sec. 10, T. 37 N., R. 3 W	39 52.20	44 19.70	do	Do.
ner sec. 10, T. 36 N., R. 4 W	35 32.80	52 39.00	do	Do.
	41°-42°	87°-88°		
	41 36 55.42	87 14 18.63	do	Do.
er of NE. ¼ sec. 6, T. 36 N., R.	36 05.10	15 40.50	do	Do.
	39°-40°	85°-86°		
ner of SE. ¼ of SE. ¼ sec. 27, ., R. 11 E.	39 01 00.87	85 16 59.40	C. & G. S	Do.

ILLINOIS.

	42°-43°	87°-88°		
	° ′ ″	° ′ ″		
	42 29 02.87	87 52 44.10	L. S	Final Rept.
d	10 20.55	50 45.94	do	Do.
n:				
er tower of Northwest University.	03 06.50	40 34.20	do	Do.
corner sec. 25, T. 41 N., R. 13 W	00 40.60	49 34.40	do	Do.
an:				
byterian church	21 41.40	50 03.30	do	Do.
t-house	21 33.90	50 58.60	do	Do.
. corner sec. 6, T. 46 N., R. 12 E	29 37.20	52 56.50	do	Do.
corner sec. 24, T. 45 N., R. 11 E	21 21.60	53 06.40	do	Do.
corner sec. 28, T. 43 N., R. 12 E	10 02.30	50 51.60	do	Do.
dge	00 58.27	49 40.50	do	Do.
	21 26.58	53 23.14	do	Do.
	42°-43°	88°-89°		
	42 26 03.67	88 03 12.50	do	Do.
	29 39.34	52 01.15	C. & G. S	Bull. 122.
Corners, Congregational h.	16 38.50	02 41.30	L. S	Final Rept.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			88°-89°				
	°	′	″	°	′	″		
Fremont	42	16	37.18	88	02	44.01	L. S	Final Rept.
Palatine		07	02.94		02	26.62	do	Do.
Spire Methodist Episcopal church		06	46.20		02	37.40	do	Do.
High school building flagstaff		06	48.80		02	31.10	do	Do.
Rock church		22	04.81		56	38.03	C. & G. S	
SW. corner sec. 14, T. 42 N., R. 10 E		06	37.50		02	38.40	L. S	Do.
SW. corner sec. 27, T. 46 N., R. 10 E		25	47.80		03	45.80	do	Do.
	42°-43°			89°-90°				
Newark	42	29	55.62	89	12	36.97	C. & G. S	
Rockton, church		27	23.19		04	15.41	do	
Roscoe, church		28	17.97		03	17.82	do	
State line No. 1		29	49.18		04	25.93	do	
Wadams Grove		24	58.94		52	02.53	do	
Warren		29	38.37		59	16.37	do	
Galena:	42°-43°			90°-91°				
Northeast corner Methodist Episcopal church.	42	25	11.50	90	25	55.70	L. S	Final Rept.
Intersection of fourth principal meridian with State line.		30	26.10		25	33.60	do	Do.
Horseshoe Mound		24	31.56		23	59.71	C. & G. S	
	41°-42°			87°-88°				
Chicago	41	50	01.00	87	50	26.78	L. S	Do.
Tower of waterworks		53	49.80		37	28.30	do	Do.
Light-house		53	20.50		36	52.20	do	Do.
Do		53	22.49		36	48.90	do	Do.
Tall tower of Chicago University		49	58.60		36	45.20	do	Do.
Shot tower		53	11.42		38	30.13	do	Do.
Crete		24	53.57		38	40.50	do	Do.
Cyrus Township, SW. corner sec. 34, T. 38 N., R. 13 W.		43	56.40		51	27.10	do	Do.
Dalton, prominent brick chimney		38	59.20		17	08.40	do	Do.
East base		45	36.06		43	36.69	do	Do.
Frankfort:								
German Lutheran church		29	45.00		50	58.80	do	Do.
Flagstaff of elevator		29	55.50		51	00.80	do	Do.
Garden		26	24.48		49	35.93	do	Do.
Grant		14	50.04		38	49.45	do	Do.
Kankakee		07	06.19		51	40.58	do	Do.
High school building tower		07	06.20		51	40.60	do	Do.
Southwest corner of water table of court-house.		07	09.00		51	38.80	do	Do.
First Baptist church spire		07	12.80		51	39.10	do	Do.
Lombard		54	07.70		59	25.02	do	Do.
Lyons Township, NE. corner sec. 13, T. 38 N., R. 13 W.		47	30.80		48	05.90	do	Do.
Manteno		14	54.96		50	07.43	do	Do.
Northeast corner Catholic church		14	48.80		50	12.50	do	Do.
Methodist church spire		15	09.00		50	16.60	do	Do.
Military Academy		41	21.85		40	32.96	do	Do.
Morgan Park		41	28.60		40	24.98	do	Do.
Baptist church		41	37.20		40	39.50	do	Do.
Orland		34	20.08		51	19.04	do	Do.
Palos Township:								
NW. corner sec. 3, T. 37 N., R. 13 W.		43	56.40		51	25.90	do	Do.
Center of sec. 13, T. 38 N., R. 13 W		47	03.60		48	41.90	do	Do.
St. Anne		01	19.46		43	16.04	do	Do.
Catholic church spire		01	36.20		43	19.60	do	Do.
West base		47	03.40		48	40.33	do	Do.
Willow Springs		43	36.93		51	06.36	do	Do.
Do		43	38.63		51	06.75	do	Do.
Center of sec. 4, T. 39 N., R. 11 E		53	49.50		59	19.40	do	Do.
Center of sec. 8, T. 30 N., R. 13 W		05	55.80		51	34.40	do	Do.
Corner secs. 10, 11, 14, and 15, T. 34 N., R. 13 W.		26	27.00		49	33.00	do	Do.
Corner secs. 15, 16, 21, and 22, T. 32 N., R. 12 E.		15	01.90		50	19.50	do	Do.
Corner secs. 27, 28, 33, and 34, T. 36 N., R. 12 E.		34	20.10		51	06.70	do	Do.
NE. corner sec. 20, T. 32 N., R. 11 W		15	07.30		37	33.30	do	Do.
NE. corner sec. 27, T. 38 N., R. 12 W		45	50.80		43	21.00	do	Do.
NW. corner sec. 4, T. 39 N., R. 11 E		54	18.40		59	54.00	do	Do.
SE. corner sec. 13, T. 37 N., R. 12 W		41	30.50		40	52.40	do	Do.
SW. corner sec. 4, T. 29 N., R. 12 W		01	15.40		43	56.80	do	Do.
SW. corner sec. 20, T. 34 N., R. 11 W		24	47.50		38	05.06	do	Do.
Rock Island:	41°-42°			90°-91°				
Southeast corner of guard-house	41	31	01.50	90	33	46.00	do	Do.
Astronomical post on U. S. Arsenal grounds.		31	03.40		33	40.10	do	Do.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			87°-88°				
	°	′	″	°	′	″		
	40	35	18.36	87	47	49.98	L. S	Final Rept.
		24	17.70		46	54.55	do	Do.
		56	14.29		56	16.74	do	Do.
st corner Congregational n.		56	08.60		56	08.90	do	Do.
ouse tower		56	15.90		56	11.00	do	Do.
		01	35.84		50	48.78	do	Do.
ist church spire		02	45.10		49	44.80	do	Do.
church spire		02	43.20		49	51.10	do	Do.
Methodist church spire		28	02.00		40	00.20	do	Do.
		12	03.60		50	12.60	do	Do.
k		40	00.18		59	30.11	do	Do.
		45	08.69		47	17.39	do	Do.
ouse tower		46	28.90		44	09.00	do	Do.
. 8, 9, 16, and 17, T. 20 N.,		12	07.10		50	45.00	do	Do.
. 33 and 34, T. 29 N., R. 14		56	35.80		56	36.50	do	Do.
sec. 2, T. 26 N., R. 13 W		46	19.00		47	11.50	do	Do.
sec. 35, T. 25 N., R. 13 W		35	19.70		47	07.30	do	Do.
sec. 8, T. 18 N., R. 13 W		01	35.30		50	37.10	do	Do.
sec. 35, T. 27 N., R. 13 W		46	19.00		47	12.50	do	Do.
sec. 35, T. 23 N., R. 13 W		24	05.00		45	46.80	do	Do.
sec. 36, T. 23 N., R. 13 W		24	05.70		45	39.00	do	Do.
of SE. ¼ of sec. 31, T. 26 W.		40	46.50		59	00.50	do	Do.
	40°-41°			88°-89°				
, Illinois Industrial Uni- enter of east tower	40	06	33.10	88	13	38.50	do	Do.
		06	52.95		07	21.47	do	Do.
		26	40.47		02	08.20	do	Do.
ational church spire		27	37.70		06	00.80	do	Do.
Evangelical Lutheran h spire.		27	23.00		05	24.40	do	Do.
		19	13.84		02	03.67	do	Do.
with cross		18	37.30		09	25.80	do	Do.
teeple		18	41.70		09	33.60	do	Do.
l chimney		01	25.60		04	10.70	do	Do.
35, T. 22 N., R. 10 E		19	12.20		01	52.20	do	Do.
. 7 and 18, T. 19 N., R. 10 cs. 12 and 13, T. 19 N., R.		06	47.80		07	28.90	do	Do.
. 14, 15, 22, and 23, T. 23 N.,		26	39.80		02	27.70	do	Do.
y corner ¼ mile E. of cor- . 14, 15, 22, and 23, T. 23 N.,		26	39.90		02	10.60	do	Do.
	40°-41°			91°-92°				
	40	18	41.16	91	26	03.69	Miss. R. C	Rept. '84.
		24	12.28		21	30.64	do	Do.
spire		23	34.60		20	52.85	do	Rept. '88.
		10	13.14		24	49.15	do	Rept. '84.
		25	16.66		21	49.71	do	Do.
		22	01.44		25	40.96	do	Do.
ist Episcopal church spire		21	40.25		26	05.39	do	Rept. '88.
erian church spire		21	33.11		26	14.81	do	Do.
		22	49.90		21	54.38	do	Rept. '84.
	39°-40°			87°-88°				
	39	10	36.33	87	52	09.33	L. S	Final Rept.
ouse tower		18	03.80		59	02.10	do	Do.
ist church steeple		17	58.40		59	27.90	do	Do.
		30	51.85		51	48.11	do	Do.
erian church spire		33	22.70		56	11.60	do	Do.
ist church spire		33	08.60		56	22.20	do	Do.
tholic church steeple		23	15.40		41	40.90	do	Do.
e		18	56.71		51	15.48	do	Do.
		52	33.82		52	03.20	do	Do.
ist church spire		36	45.60		41	41.60	do	Do.
n church steeple		36	36.20		41	38.90	do	Do.
c. 5, T. 16 N., R. 13 W		52	21.60		52	16.20	do	Do.
c. 16, T. 10 N., R. 13 W		19	03.40		51	10.60	do	Do.
secs. 4 and 5, T. 8 N., R. 13 ec. 32, T. 9 N., R. 13 W.		10	35.20		52	32.60	do	Do.
ecs. 5, 6, 7, and 8, T. 16 N.,		51	55.50		51	42.00	do	Do.
corner of sec. 4, T. 12 N.,		30	43.30		52	06.40	do	Do.
	39°-40°			88°-89°				
	39	13	33.42	88	01	07.18	do	Do.
		03	58.76		00	57.21	do	Do.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			88°-89°				
	°	'	"	°	'	"		
Lynn Grove	39	58	09.97	88	06	36.56	L. S	Final Rept.
Mattoon		29	10.00		23	08.00	do	Do.
Oakland		42	31.90		02	35.30	do	Do.
Westfield		27	15.94		02	41.66	do	Do.
Methodist church, high steeple		27	21.40		00	01.80	do	Do.
Corners of T. 18 N., R. 10 E.; T. 17 N., R. 10 E.; T. 17 N., R. 9 E., and T. 18 N., R. 9 E.		58	03.40		07	24.00	do	Do.
Corner secs. 25, 26, 35, and 36, T. 12 N., R. 10 E.		26	58.70		02	43.00	do	Do.
Land survey mark ¼ mile west of corner of secs. 25, 26, 35, and 36, T. 15 N., R. 10 E.		42	38.20		02	59.00	do	Do.
NE. corner sec. 18, T. 9 N., R. 11 E		13	57.40		00	33.60	do	Do.
NE. corner sec. 7, T. 7 N., fractional R. 11 E.		04	08.20		01	25.80	do	Do.
NW. corner sec. 7, T. 7 N., R. 14 W		04	08.30		01	25.90	do	Do.
	39°-40°			90°-91°				
Belleview	39	21	55.20	90	47	39.66	Miss. R. C	Rept. '84.
Hamburg		14	08.76		43	04.64	do	Do.
Long		28	49.67		55	27.58	do	Do.
Peets		06	18.90		39	52.86	do	Do.
Wilson		02	23.54		40	32.35	do	Do.
	39°-40°			91°-92°				
Gard	39	39	03.99	91	06	52.91	do	Do.
Marble Head		50	41.52		22	22.50	do	Do.
Inner base		29	04.94		01	19.09	do	Do.
Outer base		27	46.74		02	10.35	do	Do.
Quincy		56	31.00		24	51.18	do	Do.
Catholic church spire		55	03.63		24	17.01	do	Rept. '88.
Court-house		56	06.57		24	28.17	do	Do.
Rockport		32	48.61		00	58.40	do	Rept. '84.
	38°-39°			87°-88°				
Claremont	38	45	28.75	87	59	41.54	L. S	Final Rep
Oblong		59	54.58		52	30.54	do	Do.
SE. corner sec. 32, T. 7 N., R. 13 W		59	51.60		52	17.60	do	Do.
	38°-39°			88°-89°				Do.
Check base	38	48	20.73	88	01	58.29	do	
Denver		46	18.16		12	44.38	do	Do.
Dundas, tower Baptist church		50	06.10		05	03.60	do	Do.
East base		51	44.29		01	35.77	do	Do.
Mound		54	08.38		03	24.15	do	Do.
Olney:								
Tower schoolhouse, corner of Kitchell avenue and Church street.		43	42.00		05	12.60	do	Do.
Dome of court-house		43	50.60		05	08.70	do	Do.
Spire Immanuel's kirche		43	42.80		04	53.50	do	Do.
Onion Hill		48	57.72		10	27.97	do	Do.
Parkersburg		34	51.73		01	49.66	do	Do.
St. Marie, Catholic church		55	56.70		01	30.90	do	Do.
West base		51	38.76		06	09.04	do	Do.
Corner secs. 15, 16, 21, 22, T. 4 N., R. 9 E.		46	28.70		12	22.10	do	Do.
Corner secs. 19, 30, T. 2 N., R. 11 E., and secs. 24, 25, T. 2 N., R. 10 E.		35	07.20		02	18.60	do	Do.
NW. corner sec. 29, T. 4 N., R. 14 W		45	42.50		00	11.90	do	Do.
German Reformed church, in sec. 6, T. 4 N., R. 11 E.		48	21.10		01	59.00	do	Do.
SW. corner NW. ¼ sec. 6, T. 4 N., R. 11 E.		48	46.80		02	18.90	do	Do.
NE. corner sec. 2, T. 4 N., R. 9 E		49	03.50		10	08.40	do	Do.
NE. corner sec. 23, T. 5 N., R. 10 E		51	50.80		03	25.50	do	Do.
NE. corner sec. 21, T. 5 N., R. 10 E		51	47.90		05	41.20	do	Do.
NW. corner sec. 19, T. 5 N., R. 11 E		51	51.90		02	18.40	do	Do.
Corner secs. 1, 2, 11, 12, T. 5 N., R. 10 E		53	37.10		03	25.20	do	Do.
	38°-39°			89°-90°				
Reagan	38	01	29.48	89	59	08.01	do	Do.
	38°-39°			90°-91°				
Alton	38	53	30.96	90	11	35.62	Miss. R. C	Rept. '84.
Catholic church		53	25.88		10	39.34	do	Rept. '88.
Schoolhouse, No. 5		53	31.77		10	12.27	do	Do.
Bocan		22	13.48		15	38.69	do	Rept. '84.
Brewerville		03	35.35		03	23.89	do	Do.
Cahill		59	24.38		40	20.75	do	Do.
Calhoun		55	26.78		34	35.83	do	Do.
Clark Mound		34	45.75		04	13.97	do	Do.
County Line		06	42.21		07	21.36	do	Do.
Droege		58	44.77		37	23.26	do	Do.

ILLINOIS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			90°-91°				
	°	′	″	°	′	″		
Dryer	38	20	06.33	90	11	55.71	Miss. R. C	Rept. '84.
Eagle Nest		56	04.97		18	40.13	do	Do.
Elsah		57	20.64		22	10.12	do	Do.
Gesler		50	51.51		06	26.25	do	Do.
Glass Works		53	02.06		10	20.84	do	Do.
Gillan		49	36.43		06	32.02	do	Do.
Grafton		58	22.48		27	08.82	do	Do.
Gummershimer		25	43.98		13	42.67	do	Do.
Hop Hollow		54	41.55		13	13.21	do	Do.
Hull		55	11.39		14	09.35	do	Do.
Keel		56	58.38		39	04.41	do	Do.
Kidd		10	22.49		12	58.13	do	Do.
Moore		48	08.12		07	05.82	do	Do.
Point Landing		54	43.53		31	44.55	do	Do.
Pettingill		46	16.76		08	50.56	do	Do.
Reihl		56	12.34		16	40.01	do	Do.
Ringering		51	32.91		07	48.91	do	Do.
Rivermouth		58	21.92		29	41.17	do	Do.
Russell		52	31.18		08	41.63	do	Do.
Salt Bluff		18	35.65		18	05.65	do	Do.
Sawmill		53	55.24		12	10.29	do	Do.
Soechtig		43	03.85		08	50.74	do	Do.
Starr		56	29.12		20	06.18	do	Do.
Sugarloaf		42	05.33		00	28.91	do	Do.
Thompson		58	43.32		32	28.42	do	Do.
Weisenborn		14	24.24		16	26.40	do	Do.
	37°-38°			89°-90°				
Atherton	37	07	23.82	89	22	43.05	do	Do.
Big Muddy		34	32.97		26	08.67	do	Do.
Bluff Lake		25	17.94		20	42.20	do	Do.
Burnham		08	31.43		24	32.43	do	Do.
Chester		54	09.65		48	43.55	do	Do.
Chester, church spire		54	55.36		49	21.22	do	Rept. '88.
Clear Creek		19	56.75		22	44.84	do	Rept. '84.
Day		14	00.04		27	14.93	do	Do.
Dickey		04	08.17		14	43.21	do	Do.
Fountain Bluff		41	36.77		30	00.16	do	Do.
Goose Island		05	35.96		22	58.78	do	Do.
Kaskaskia		57	41.83		55	07.40	do	Rept. '88.
Lassar		11	05.83		26	16.30	do	Rept. '84.
Manskeer		51	54.74		44	40.35	do	Do.
Murray		04	59.32		15	55.00	do	Do.
Nimbus		03	09.04		13	02.69	do	Do.
North base		02	21.94		11	31.84	do	Do.
O'Harrah		49	21.42		38	41.57	do	Do.
Powers Island		07	26.46		24	39.71	do	Do.
Promised Land		05	10.41		20	54.05	do	Do.
Rich		30	37.42		25	58.33	do	Do.
Santa Fe		10	05.16		25	28.60	do	Do.
Scudder		04	25.09		18	35.23	do	Do.
Sexton		15	05.07		26	42.99	do	Do.
South base		01	28.97		11	23.19	do	Do.
Spiese Mill		05	29.90		17	59.58	do	Do.
Swallow Rock		41	31.23		24	19.67	do	Do.
Thebes		12	30.91		27	15.55	do	Do.
Worthen		46	13.45		28	24.07	do	Do.
	36°-37°			89°-90°				
Cairo	36	59	47.99	89	09	31.20	L. S	Final Rept.

MICHIGAN.

Name.	Latitude.			Longitude.			Authority.	Reference.
	48°-49°			88°-89°				
	°	′	″	°	′	″		
Isle Royale	48	07	43.58	88	33	37.91	L. S	Final Rept.
Light-house		05	23.60		34	45.60	do	Do.
	47°-48°			87°-88°				
Stannard Rock, day beacon	47	10	37.70	87	13	23.10	do	Do.
Vulcan		26	46.65		47	38.17	do	Do.
	47°-48°			88°-89°				
Franklin shaft house	47	08	33.40	88	34	10.20	do	Do.
Traverse Point		08	42.06		13	59.86	do	Do.
Wheat Kate		04	20.27		39	45.21	do	Do.
	46°-47°			85°-86°				
Biddle Point	46	04	32.01	85	22	41.20	do	Do.
Manitou Payment		01	47.76		05	15.61	do	Do

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	46°-47°			86°-87°				
	°	′	″	°	′	″		
Divide	46	21	41.12	86	39	37.71	L. S	Final Rept.
Grand Island		31	43.34		41	35.49	do	Do.
Manistique		08	31.57		35	55.05	do	Do.
Mud Lake		19	14.00		48	24.45	do	Do.
Shelter Bay		28	17.93		59	16.95	do	Do.
Sturgeon		02	26.07		41	10.95	do	Do.
NW. corner of NE. ¼ sec. 16, T. 42 N., R. 19 W.		02	31.40		41	17.40	do	Do.
NE. corner sec. 27, T. 46 N., R. 19 W		21	44.00		39	27.70	do	Do.
SE. corner sec. 4, T. 45 N., R. 20 W		19	06.50		48	13.90	do	Do.
	46°-47°			87°-88°				
Baldwin	46	32	57.85	87	35	05.25	G. S	Bull. 122
Carp		30	06.70		25	05.84	do	Do.
Dexter		30	02.57		47	33.91	do	Do.
F		28	18.28		36	55.47	do	Do.
Granite Island		43	15.47		24	41.29	L. S	Final Rept.
Light-house		43	15.00		24	43.70	do	Do.
Huron Island light-house		57	47.70		59	56.40	do	Do.
Huron Mountains		52	42.30		55	17 59	do	Do.
Ives Hill		49	26.19		50	05.66	do	Do.
Marquette:								
Light-house		32	47.90		22	34.70	do	Do.
Methodist church spire		32	43.40		23	31.70	do	Do.
City hall dome		32	30.00		23	47.60	do	Do.
Mount Mesnard		30	48.34		23	59.23	do	Do.
Morgan		31	48.26		30	55.32	G. S	Bull. 122.
Saginaw		27	41.10		43	00.52	do	Do.
Triloba		36	17.94		29	21.83	L. S	Final Rept
	46°-47°			88°-89°				
Crebassa	46	59	00.52	88	24	18.17	do	Do.
Middle		55	55.09		14	22.75	do	Do.
North base		56	48.01		26	59.46	do	Do.
Portage River light-houso		58	41.10		24	50.70	do	Do.
Quaquaming		52	20.23		22	21.79	do	Do.
South base		52	17.76		29	16.75	do	Do.
	46°-47°			89°-90°				
Ontonagon County light-house	46	52	27.60	89	19	33.40	do	Do.
Porcupine Mountain		47	01.05		43	50.84	do	Do.
	45°-46°			84°-85°				
Beaver Tail	45	57	56.72	84	10	15.24	do	Do.
Bois Blanc Island		46	19.12		21	21.47	do	Do.
East base		45	22.14		42	02.99	do	Do.
Gros Cap		52	57.81		50	06.98	do	Do.
Mackinac Island		51	28.73		36	58.03	do	Do.
Mast		34	28.44		08	25.89	do	Do.
Pointe aux Chênes		55	39.82		54	48.49	do	Do.
Pointe Fuyard		55	58.07		22	48.77	do	Do.
Pointe St. Martin		58	10.21		31	55.29	do	Do.
Rabbit Back		55	17.84		43	18.97	do	Do.
Round Island astronomical station		50	06.81		36	44.60	do	Do.
St. Ignace		51	09.12		43	36.09	do	Do.
Spectacle Reef		46	05.02		08	10.73	do	Do.
West base		47	13.80		46	22.40	do	Do.
	45°-46°			85°-86°				
Beaver Island	45	36	25.56	85	29	49.27	do	Do.
Cathead		10	58.09		37	05.65	do	Do.
Garden Island		49	19.46		31	13.82	do	Do.
Gull Island		42	09.24		50	00.32	do	Do.
Hat Island		49	01.87		17	57.18	do	Do.
High Island		43	54.35		41	01.50	do	Do.
Middle Village		34	42.39		06	13.43	do	Do.
North Fox		28	09.94		46	26.25	do	Do.
North Manitou		03	51.52		59	44.32	do	Do.
Pine River		19	55.73		14	50.43	do	Do.
Point Patterson		58	04.29		39	15.18	do	Do.
Seul Choix		55	14.69		54	40.40	do	Do.
Scott Point		57	34.63		41	44.46	do	Do.
South Fox		24	58.05		51	37.49	do	Do.
	45°-46°			86°-87°				
Boyer Bluff	45	25	12.81	86	56	11.49	do	Do.
Burnt Bluff		41	09.73		42	39.83	do	Do.
Fishdam		57	37.33		29	34.19	do	Do.
Northwest Manitou		09	23.00		02	46.52	do	Do.
Peninsula Point light-house		40	04.60		58	02.40	do	Do.
Pine Hill		51	36.96		53	55.48	do	Do.
Rock Island		24	53.11		49	00.00	do	Do.
South Manitou		00	35.24		09	01.74	do	Do.

MICHIGAN—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46°	87°-88°		
	° ′ ″	° ′ ″		
	45 34 30.78	87 14 25.94	L. S.	Final Rept.
r	25 48.62	19 35.05	do	Do.
	17 46.97	03 54.60	do	Do.
	41 05.34	06 01.35	do	Do.
	41 12.16	06 09.40	do	Do.
, new primary triangula- on.	05 12.78	35 27.75	do	Do.
	17 41.23	26 12.51	do	Do.
sec. 12, T. 38 N., R. 23 W	41 12.90	06 03.40	do	Do.
	44°-45°	82°-83°		
Barques	44 04 05.58	82 57 32.52	do	Do.
	44°-45°	83°-84°		
	44 02 17.46	83 26 27.97	do	Do.
ht-house	02 16.30	26 27.70	do	Do.
oint	02 58.79	34 44.06	do	Do.
ity	00 08.81	28 02.72	do	Do.
k	11 39.56	33 20.34	do	Do.
able	20 17.79	20 03.64	do	Do.
t-house	15 35.40	26 37.70	do	Do.
nt	15 38.14	26 29.19	do	Do.
	06 24.72	33 54.33	do	Do.
	44°-45°	85°-86°		
oint	44 58 04.40	85 55 28.16	do	Do.
	44°-45°	86°-87°		
Becs Scies	44 41 48.58	86 14 59.36	do	Do.
ear	52 22.69	04 08.05	do	Do.
	43°-44°	83°-84°		
	43 54 55.71	83 19 10.78	do	Do.
	42 49.02	31 39.49	do	Do.
tion of Keasley and East s.	01 11.71	41 06.45	do	Do.
tion of Keasley and Sagi- treets.	01 01.20	41 29.30	do	Do.
tion of Calhoun and Lib- treets.	03 08.60	18 53.50	do	Do.
tion of Calhoun and klin streets.	03 07.30	18 53.40	do	Do.
	47 24.74	55 32.76	do	Do.
	58 29.77	15 40.03	do	Do.
y	54 39.79	22 51.00	do	Do.
	58 42.70	51 13.62	do	Do.
Gres	59 27.88	40 38.96	do	Do.
see	37 03.81	44 10.09	do	Do.
iver light-house	38 37.80	51 17.50	do	Do.
ouse, east corner	25 05.70	57 50.30	do	Do.
uth corner	25 08.40	57 48.40	do	Do.
ction of Adams and Wash- n streets.	25 02.00	57 50.20	do	Do.
	51 32.16	26 57.65	do	Do.
	54 39.15	23 56.71	do	Do.
	51 24.53	21 28.39	do	Do.
sec. 26, T. 12 N., R. 4 E	25 27.10	57 25.30	do	Do.
of SW. ¼ of sec. 32, T. 8 E.	03 26.30	18 55.60	do	Do.
	43°-44°	84°-85°		
ction of axes of State and va streets.	43 00 02.60	84 33 47.00	do	Do.
stone at northwest corner urt-house.	00 00.10	33 37.20	do	Do.
ction of axes of Clinton e and State street.	00 02.39	33 36.60	do	Do.
ntersection of Washing- Mill streets.	24 33.00	36 24.70	do	Do.
sec. 16, T. 7 N., R. 2 W	00 02.80	33 51.10	do	Do.
sec. 19, T. 12 N., R. 2 W	24 33.00	36 19.00	do	Do.
	43°-44°	85°-86°		
record office, northwest r.	43 17 29.00	85 04 58.40	do	Do.
ction of Main and Cam- streets.	17 30.70	04 52.50	do	Do.
rner sec. 31, T. 11 N., R. 6 W	17 30.70	05 03.20	do	Do.
rner sec. 18, T. 12 N., R. 12 W	25 26.10	48 10.40	do	Do.
	42°-43°	83°-84°		
	42 07 39.50	83 08 26.30	do	Do.
	08 02.90	08 17.80	do	Do.

MICHIGAN—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	83°-84°		
	° ′ ″	° ′ ″		
Brodhead	42 09 30.50	83 08 15.90	L. S	Final Rept.
Detroit:				
Astronomical post (east pier) in lake observatory.	20 00.80	03 07.40	do	Do.
Intersection of axes of Washington and Grand River avenues.	20 01.40	03 04.50	do	Do.
Spire St. Paul's Episcopal church, on northeast corner of Congress and Shelby streets.	19 45.90	02 53.60	do	Do.
Tower of fire-engine house on Russell street.	20 41.00	02 21.50	do	Do.
East pier lake survey observatory.	19 58.65	03 03.60	do	Do.
Ecorse	15 21.40	08 09.50	do	Do.
Field	17 34.20	03 23.10	do	Do.
Howell:				
Astronomical post	36 00.24	55 44.25	Engr. Corps	Rept. '76.
Intersection Higgins and Monroe streets.	36 11.18	55 50.85	L. S	Final Rept.
Intersection of axes of Grand River and Higgins streets.	36 23.20	55 42.60	do	Do.
Southwest corner of court-house.	36 24.50	55 41.40	do	Do.
North Wyandotte	12 49.20	08 48.50	do	Do.
Pointe Monillée	00 49.60	10 53.70	do	Do.
Pontiac:				
Methodist Episcopal church spire.	38 03.20	17 20.50	do	Do.
Intersection of axes of Saginaw and Church streets.	38 06.70	17 22.60	do	Do.
Court-house cupola	38 22.00	17 30.00	do	Do.
SE. corner sec. 29, T. 3 N., R. 10 E	38 06.95	17 15.60	do	Do.
River Rouge	16 15.40	07 34.90	do	Do.
Tecumseh Presbyterian church	00 15.00	56 54.60	do	Do.
Sugar Island	05 25.40	08 35.40	do	Do.
NW. corner sec. 1, T. 2 N., R. 4 E	35 59.60	56 01.60	do	Do.
SE. corner, sec. 29, T. 3 N., R. 10 E	38 07.00	17 15.50	do	Do.
	42°-43°	84°-85°		
Bunday	42 03 16.04	84 27 42.10	do	Do.
Charlotte:				
Intersection of axes of Oliver and Stoddard streets.	33 58.96	50 01.20	do	Do.
Jail, northwest corner	33 52.40	50 13.90	do	Do.
Corunna:				
Intersection of axes of McArthur street and Shiawassee avenue.	58 52.00	07 02.90	do	Do.
Intersection of axes of Shiawassee avenue and Flint road.	58 37.92	07 02.85	do	Do.
Court-house, southwest corner	58 54.30	07 00.80	do	Do.
Northeast corner schoolhouse on corner of State street and Shiawasseo avenue.	58 47.50	07 05.00	do	Do.
Jackson:				
Cornwell & Emerson's chemical works, brick chimney.	15 45.50	24 23.90	do	Do.
Hibbard House, northeast corner.	14 48.90	24 13.70	do	Do.
First Methodist Episcopal church spire.	14 50.00	24 39.60	do	Do.
Intersection of axes of Main and Mechanics streets.	14 49.40	24 19.20	do	Do.
Michigan State Prison, main tower	14 34.70	24 36.60	do	Do.
Intersection of axes of Main and Jackson streets.	14 49.40	24 30.00	do	Do.
Lansing:				
Dome of capitol	43 56.10	33 23.20	do	Do.
Intersection of Washtenaw and Washington avenues.	43 47.60	33 11.20	do	Do.
Intersection of Michigan and Capitol avenues.	43 55.79	33 16.95	do	Do.
Marshall.				
Intersection of Kalamazoo avenue and Mansion street.	16 24.70	57 49.20	do	Do.
Court-house, northwest corner	16 16.70	57 47.00	do	Do.
NE. corner sec. 16, T. 4 N., R. 2 W	44 21.90	32 37.40	do	Do.
NE. corner sec. 13, T. 2 N., R. 5 W	34 04.30	50 10.10	do	Do.
NW. corner sec. 2, T. 3 S., R. 1 W	14 49.30	24 12.40	do	Do.
NW. corner sec. 25, T. 2 S., R. 6 W	16 27.60	57 49.20	do	Do.
SE. corner sec. 8, T. 5 S., R. 1 W	03 55.00	29 00.40	do	Do
SW. corner sec. 28, T. 7 N., R 3 E	58 11.20	07 40.30	do	Do.
	42°-43°	85°-86°		
Allegan:				
County record building, northwest corner.	42 31 44.70	85 51 08.50	do	Do.

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			85°-86°				
	°	′	″	°	′	″		
Allegan—Continued.								
Intersection of axes of Walnut and Trowbridge streets.	42	31	45.60	85	51	09.70	L. S.	Final Rept.
Northwest corner county building, public square.		31	44.74		51	08.55	do	Do.
Grand Rapids:								
SW. corner of NW. ¼ of sec. 30, T. 7 N., R. 11 W., at intersection of Fulton and Division streets.		57	47.00		40	06.20	do	Do.
Intersection of axes of Fulton street and Jefferson avenue.		57	47.10		39	52.90	do	Do.
Hastings:								
Intersection of Church and State streets.		38	54.13		17	17.55	do	Do.
Court-house, southwest corner		38	51.60		17	20.40	do	Do.
Intersection of axes of Broadway and Court streets.		38	50.70		17	23.00	do	Do.
Ionia:								
Intersection of axes of Main and Kidd streets.		58	51.90		03	47.00	do	Do.
Intersection of axes of Main and First streets.		58	51.39		03	53.25	do	Do.
Southeast corner of corner stone of projected soldiers' monument.		58	52.90		03	49.70	do	Do.
Kalamazoo:								
Intersection of axes of South and Church streets.		17	24.60		35	07.30	do	Do.
Intersection of axes of South and Park streets.		17	24.46		35	11.70	do	Do.
Jail, southwest corner		17	28.40		35	05.70	do	Do.
Paw Paw, intersection of axes of Main and Van Buren streets.		13	01.70		53	03.40	do	Do.
NW. corner sec. 17, T. 3 N., R. 8 W		39	11.60		17	23.30	do	Do.
NW. corner sec. 28, T. 2 N., R. 13 W		32	10.50		51	32.10	do	Do.
SE. corner of NE. ¼ of sec. 19, T. 7 N., R. 6 W.		58	42.10		03	18.60	do	Do.
SW. corner sec. 7, T. 3 N., R. 13 W		12	55.00		52	40.40	do	Do.
SW. corner sec. 15, T. 2 S., R. 11 W		17	21.00		35	20.10	do	Do.
	42°-43°			86°-87°				
St. Joseph, Congregational church spire.	42	06	19.00	86	29	00.10	do	Do.
SW. corner sec. 36, T. 1 N., R. 17 W		25	03.80		15	56.30	do	Do.
	41°-42°			83°-84°				
Bedford	41	49	11.15	83	37	06.14	do	Do.
Blissfield		51	08.39		48	27.86	do	Do.
Dundee		55	28.08		40	13.93	do	Do.
Middle Sister		50	53.03		00	07.80	do	Do.
Monroe		55	04.51		28	16.17	do	Do.
Court-house steeple		54	48.65		23	46.35	do	Do.
Methodist Episcopal church spire		54	52.40		23	56.60	do	Do.
Presbyterian church spire		54	53.40		23	51.40	do	Do.
German Lutheran church spire		54	43.40		23	49.10	do	Do.
Light-house		53	27.70		19	53.20	do	Do.
Raisin		57	11.50		55	30.14	do	Do.
Stony Point		55	53.86		15	51.33	do	Do.
Corner of secs. 14, 15, 22, and 23, T. 6 S., R. 4 E.		56	57.10		55	34.30	do	Do.
Corner of secs. 22, 23, 26, and 27, T. 7 S., R. 5 E.		50	57.00		48	26.90	do	Do.
Corner of secs. 25, 26, 35, and 36, T. 6 S., R. 6 E.		55	28.20		40	18.70	do	Do.
NE. corner sec. 5, T. 8 S., R. 7 E.		49	19.80		36	32.40	do	Do.
	41°-42°			84°-85°				
Adrian, flagstaff on engine house	41	53	45.40	84	01	36.80	do	Do.
Fairfield		48	56.12		02	37.00	do	Do.
Hillsdale		55	14.25		39	01.08	do	Do.
Court-house dome		55	15.40		37	54.60	do	Do.
College clock tower		55	57.00		38	02.00	do	Do.
Hudson Congregational church spire		51	12.60		21	25.80	do	Do.
Pittsford		49	33.25		29	00.51	do	Do.
Prattville church		46	50.10		24	00.10	do	Do.
Quincy		57	40.01		55	20.05	do	Do.
Reading		50	06.06		44	31.56	do	Do.
Schoolhouse cupola		50	16.20		44	45.40	do	Do.
Colby Wringer Co. factory, southeast corner.		50	07.10		44	33.20	do	Do.
First Baptist church spire		50	18.50		44	46.80	do	Do.
Wheatland		55	06.32		27	19.48	do	Do.
Woodstock		59	12.55		15	35.76	do	Do.

MICHIGAN—Continued.

Name.	Latitude.			Longitude.			Authority.	Referenc
	41°-42°			84°-85°				
	°	′	″	°	′	″		
Corner of secs. 19, 20, 29, and 30, T. 6 S., R. 1 E.	41	55	38.60	84	27	34.20	L. S.	Final Re
Corner of secs. 22, 23, 26, and 27, T. 7 S., R. 4 W.		50	22.70		44	53.20	do	Do.
NE. corner sec. 3, T. 8 S., R. 3 E.		49	00.20		02	30.10	do	Do.
NE. corner sec. 4, T. 6 S., R. 1 E.		59	11.90		14	46.60	do	Do.
NE. corner sec. 26, T. 7 S., R. 4 W.		50	22.40		43	42.60	do	Do.
NW corner sec. 27, T. 6 S., R. 3 W.		55	38.10		39	05.00	do	Do.
SE. corner sec. 36, T. 7 S., R. 2 W.		48	41.00		28	34.80	do	Do.
SW. corner of SW. ¼ of sec. 7, T. 6 S., R. 5 W.		57	22.70		55	55.70	do	Do.
SW. corner of NW. ¼ of sec. 27, T. 6 S., R. 3 W.		55	11.90		39	05.10	do	Do.
SW. corner of NW. ¼ of sec. 29, T. 6 S., R. 1 W.		55	12.70		27	34.20	do	Do.
	41°-42°			85°-86°				
Bronson	41	51	22.46	85	14	38.98	do	Do.
Calvin		50	10.38		55	27.18	do	Do.
Constantine schoolhouse, north cupola		50	07.10		40	01.10	do	Do.
Porter		49	22.48		46	00.10	do	Do.
Sherman		50	48.58		27	12.45	do	Do.
Sturgis:								
Presbyterian church spire		48	03.50		25	08.50	do	Do.
Methodist Episcopal church spire		48	01.20		25	08.80	do	Do.
Schoolhouse		48	05.60		25	11.20	do	Do.
Three Rivers:								
Tall steeple		56	54.20		38	04.50	do	Do.
Church		56	59.00		38	06.30	do	Do.
White Pigeon:								
First Baptist church		47	47.40		38	35.40	do	Do.
Woolen mill		47	41.90		38	28.90	do	Do.
SW. corner of SW. ¼ of sec. 16, T. 7 S., R. 8 W.		51	16.10		14	36.00	do	Do.
SW. corner of SE. ¼ of sec. 22, T. 7 S., R. 10 W.		50	21.40		27	28.80	do	Do.
SW. corner of NW. ¼ of sec. 27, T. 7 S., R. 14 W.		49	57.70		56	07.30	do	Do.
SW. corner of NW. ¼ of sec. 36, T. 7 S., R. 13 W.		48	59.40		46	47.40	do	Do.
	41°-42°			86°-87°				
Bald Tom	41	54	19.34	86	35	59.45	do	Do.
Bertrand		46	44.96		22	40.33	do	Do.
Milton		48	09.36		10	29.74	do	Do.
Corner secs. 4, 5, 8, and 9, T. 8 S., R. 16 W.		47	49.80		11	10.30	do	Do.
Corner secs. 14, 15, 22, and 23, T. 8 S., R. 18 W.		46	34.90		22	39.70	do	Do.
SE. corner sec. 35, T. 6 S., R. 20 W.		53	58.60		35	23.90	do	Do.

WISCONSIN.

Name.	Latitude.			Longitude.			Authority.	Referenc
	47°-48°			90°-91°				
	°	′	″	°	′	″		
Outer Island	47	04	17.09	90	26	27.25	L. S.	Final Re
	46°-47°			90°-91°				
Bayfield County:								
Light-house on Raspberry Island	46	58	12.80	90	48	16.70	do	Do.
Light-house on Michigan Island		52	16.30		29	48.80	do	Do.
Detour		56	36.68		58	09.32	do	Do.
	46°-47°			91°-92°				
Aminicon	46	41	32.14	91	51	43.59	do	Do.
Brulé		45	17.89		35	18.79	do	Do.
Clay Banks		49	05.61		18	40.63	do	Do.
	46°-47°			92°-93°				
South base	46	42	49.44	92	01	55.13	do	Do.
	45°-46°			86°-87°				
Door County, light-house on Rock Island (Pottawatomie).	45	25	39.50	86	49	41.60	do	Do.
Boyer Bluff		25	12.74		56	11.48	do	Do.
	45°-46°			87°-88°				
Door Bluff	45	17	46.97	87	03	54.60	do	Do.
Door County, light-house on Eagle Bluff.		10	07.50		14	12.30	do	Do.
Do		12	08.20		21	53.60	do	Do.
Eagle Bluff		10	06.62		14	13.66	do	Do.
Menomonee		05	12.76		35	34.60	do	Do.

WISCONSIN—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46°	87°-88°		
Oconto County:	° ′ ″	° ′ ″		
NE. corner sec. 3, T. 30 N., R. 23 E.	45 06 24.20	87 39 42.90	L. S	Final Rept.
Light-house on Green Island	03 23.20	29 34.60	do	Do.
St. Croix County:	45°-46°	92°-93°		
SE. corner sec. 34, T. 31 N., R. 19 W.	45 07 21.80	92 41 24.60	do	Do.
SW. corner sec. 33, T. 31 N., R. 19 W.	07 22.10	43 52.10	do	Do.
	44°-45°	87°-88°		
Brown County, NW. corner sec. 25, T. 24 N., R. 21 E.	44 31 53.70	87 54 25.20	do	Do.
Bruce	31 39.37	53 58.14	do	Do.
Debroux	50 19.43	36 28.84	do	Do.
Gales	51 14.48	51 26.86	do	Do.
Little Tail	41 14.76	59 23.07	do	Do.
Long Tail Point	35 49.10	58 59.20	do	Do.
Peshtigo	59 06.73	37 43.23	do	Do.
Red Banks	36 40.26	51 54.19	do	Do.
Red River	45 40.00	41 07.07	do	Do.
South Egg	59 20.75	21 05.79	do	Do.
	44°-45°	88°-89°		
Appleton, St. Lawrence University, center of dome.	44 15 39.20	88 23 58.80	do	Do.
Calumet	10 12.64	16 45.78	do	Do.
County, NW. corner sec. 31, T. 20 N., R. 19 E.	10 12.80	17 02.20	do	Do.
Clayton	12 04.07	32 41.11	do	Do.
East Depere	24 19.52	00 27.38	do	Do.
Fort Howard	30 30.28	02 34.05	do	Do.
Freedom	20 06.61	22 00.92	do	Do.
Green Bay, court-house dome	30 50.90	00 48.00	do	Do.
Oneida	31 36.53	10 09.68	do	Do.
Outagamie County, SE. corner sec. 35, T. 21 N., R. 17 E.	14 38.70	23 43.70	do	Do.
Oshkosh	01 13.64	32 28.14	do	Do.
Stockbridge	06 16.17	19 26.12	do	Do.
West Depere	24 12.73	16 16.02	do	Do.
Winnebago County, SW. corner sec. 13, T. 20 N., R. 16 E.	11 58.90	32 39.30	do	Do.
Monroe County:	44°-45°	90°-91°		
NE. corner sec. 1, T. 18 N., R. 1 W.	44 04 26.60	90 25 56.70	do	Do.
SE. corner sec. 13, T. 18 N., R. 1 W.	01 49.60	25 56.00	do	Do.
Valley Junction, SW. corner sec. 31, T. 21 N., R. 3 E.	14 57.24	25 56.70	do	Do.
Milwaukee:	43°-44°	87°-88°		
Court-house, axis of figure of Justice.	43 02 31.80	87 54 18.40	do	Do.
Catholic church spire	02 30.50	54 15.00	do	Do.
	43°-44°	88°-89°		
Brown church	43 16 42.19	88 52 53.63	C. & G. S	
Canty	23 19.58	04 37.41	G. S	Bull. 122.
Delafield	01 56.97	23 34.00	L. S	Final Rept.
Do	01 59.46	23 29.35	C. & G. S	
Dodge County:				
SW. corner of SE. ¼ sec. 24, T. 12 N., R. 15 E.	28 24.50	44 01.90	L. S	Do.
NW. corner of SW. ¼ sec. 3, T. 9 N., R. 16 E.	16 36.00	35 48.60	do	Do.
SW. corner sec. 3, T. 9 N., R. 16 E.	16 09.70	35 48.30	do	Do.
SE. corner sec. 33, T. 12 N., R. 16 E.	27 28.60	34 52.60	do	Do.
NW. corner sec. 3, T. 13 N., R. 16 E.	37 53.70	34 55.10	do	Do.
SE. corner of SW. ¼ sec. 33, T. 11 N., R. 17 E.	22 14.30	29 29.00	do	Do.
SE. corner sec. 32, T. 11 N., R. 17 E.	22 14.30	30 04.70	do	Do.
East base	42 39.67	28 42.05	do	Do.
Eldorado	52 20.81	34 54.97	do	Do.
Erin	14 39.00	19 39.88	G. S	Bull. 122.
Do	14 41.49	19 35.18	C. & G. S	
Fond du Lac County:				
Spire of Catholic church in Byron Township.	40 29.00	27 02.50	L. S	Final Rept.
NE. corner sec. 10, T. 14 N., R. 16 E.	42 19.00	33 47.30	do	Do.
SW. corner sec. 10, T. 16 N., R. 16 E.	51 54.30	35 03.80	do	Do.
NW. corner SW. ¼ sec. 34, T. 14 N., R. 16 E.	38 22.50	34 54.90	do	Do.
SW. corner sec. 34, T. 14 N., R. 16 E.	37 56.60	34 54.30	do	Do.
NW. corner sec. 4, T. 14 N., R. 17 E.	43 08.60	28 56.10	do	Do.
SW. corner sec. 20, T. 16 N., R. 18 E.	50 01.70	22 55.40	do	Do.
Holl	20 41.62	15 51.27	G. S	Bull. 122.
Horicon	28 11.07	34 54.84	L. S	Final Rept.

WISCONSIN—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference
	43°-44°	88°-89°		
Jefferson:	° ′ ″	° ′ ″		
Catholic church	43 00 20.30	88 46 41.19	C. & G. S	
Methodist Episcopal church	00 27.10	48 05.67	do	
Kewaskum	29 36.18	13 33.43	G. S	Bull. 122.
Lebanon	16 37.61	35 29.84	C. & G. S	
Do	16 35.13	35 34.51	L. S	Final Rep
Minnesota Junction	28 28.45	43 47.54	do	Do.
New Lisbon	08 16.85	11 57.32	do	Do.
Oakfield	38 20.04	34 36.51	do	Do.
Springvale	46 05.32	43 54.06	do	Do.
Taycheedah	50 06.63	22 19.17	do	Do.
Watertown, church	11 43.03	43 39.49	C. & G. S	
Waupun	37 45.11	43 49.81	L. S	Do.
West base	41 50.58	34 06.62	do	Do.
Woodland	22 37.90	28 51.60	G. S	Bull. 122.
Do	22 14.71	29 50.48	L. S	Final Rept
	43°-44°	89°-90°		
Arena, church belfry	43 09 53.11	89 54 46.38	C. & G. S	
Arlington	19 42.84	18 14.00	do	
Blue Mounds	01 43.57	51 04.60	do	
Burke	07 01.65	16 48.41	do	
Courtland	30 04.98	06 37.52	do	
Deerfield, church	02 29.06	06 21.96	do	
Devils Lake	24 03.37	43 41.59	do	
Fitz Simmons	25 42.56	39 10.30	do	
Gibraltar	20 37.75	35 56.06	do	
Insane asylum	08 00.13	23 48.29	do	
Liberty Mound	01 00.30	09 40.75	do	
McFarland, church	00 57.78	17 05.04	do	
Madison:				
Astronomic station (1873), stone	04 33.03	24 03.41	do	
Baptist church	04 26.44	23 01.13	do	
Capitol	04 31.42	22 58.22	do	
City Hall	04 34.43	23 04.24	do	
Episcopal church	04 28.73	23 03.96	do	
Congregational church	04 26.52	23 07.18	do	
Irish Catholic church	04 22.23	23 04.41	do	
Presbyterian church	04 40.23	23 08.53	do	
University	04 33.81	24 10.39	do	
Mazomanie church, white steeple	10 42.56	47 47.55	do	
Medina	07 36.96	02 11.84	do	
Norwegian church	00 23.86	41 24.11	do	
Observatory Hill	42 22.04	20 29.06	do	
Springfield	10 30.04	36 47.84	do	
St. Martin's church	10 55.68	35 21.23	do	
Stewart	12 01.90	56 37.26	do	
Sun Prairie, highest church spire	11 08.97	12 36.13	do	
Windsor	14 23.94	16 18.35	do	
	43°-44°	90°-91°		
Bear Bluff	43 13 04.04	90 08 35.23	do	
Big Hollow	12 45.42	05 43.04	do	
Brown church steeple	02 55.67	16 45.80	do	
Helena	09 03.44	00 30.78	do	
Railroad bridge, bolt	10 28.79	01 50.08	do	
Highland	06 06.55	21 51.28	do	
Catholic church	02 49.26	22 53.51	do	
Lone Rock:				
Church spire	11 02.75	11 57.53	do	
Bluff	09 54.20	13 00.66	do	
Meridian station, 2	07 57.51	25 43.07	do	
Pine Knobs	04 38.46	01 59.09	do	
Point Judas	13 07.82	13 53.99	do	
Quarry Bluff	12 23.38	03 26.63	do	
Spring Green:				
Methodist Episcopal church spire	10 43.38	04 05.38	do	
Base, east end	09 41.40	03 45.04	do	
Base, west end	10 46.50	06 52.10	do	
Wyoming	04 28.92	10 54.38	do	
	42°-43°	87°-88°		
Caledonia	42 45 32.89	87 56 48.43	L. S	Final Rep
Kenosha, Catholic church spire	35 32.90	49 17.70	do	Do.
Racine, Methodist Episcopal church	43 28.70	46 56.90	do	Do.
Somer	37 10.07	52 33.60	do	Do.
	42°-43°	88°-89°		
Bald Bluff	42 50 42.76	88 36 15.73	C. & G. S	
Bristol	32 51.61	02 08.78	L. S	Do.
Clinton:				
Norwegian Lutheran church	29 37.73	50 35.04	C. & G. S	
Junction church	33 41.82	51 38.34	do	
Darien church	35 59.85	42 24.49	do	

WISCONSIN—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	88°-89°		
	° ′ ″	° ′ ″		
	42 40 25.35	88 05 03.68	L. S	Final Rept.
	37 07.79	32 08.96	C. & G. S.	
y.	42 34.43	55 16.83	do	
lin	58 17.60	11 01.80	L. S	Do.
	59 14.40	53 45.16	C. & G. S.	
church	34 16.69	56 12.62	do	
rd	47 34.91	13 50.73	L. S	Do.
ter	50 13.32	44 33.45	C. & G. S.	
regational church	50 05.05	44 05.54	do	
a County, NW. corner sec. N., R. 20 E.	58 25.80	11 16.30	L. S	Do.
	42°-43°	89°-90°		
school	42 30 06.17	89 01 30.66	C. & G. S.	
ge, main building	30 13.36	01 46.84	do	
ist church	30 01.65	01 53.45	do	
regational church	30 08.13	01 35.79	do	
orial Hall	30 08.66	01 44.94	do	
byterian church	29 57.06	01 55.71	do	
ial, Methodist Episcopal	42 19.25	59 04.74	do	
of the Disciples	42 33.71	10 49.25	do	
n church	50 13.44	04 13.89	do	
le, seminary	46 39.22	18 03.02	do	
	43 16.80	59 38.09	do	
g	58 45.77	26 07.65	do	
le	42 47.86	03 39.79	do	
Institute	39 55.91	02 20.37	do	
school	40 57.56	00 53.22	do	
a	42 29.04	17 44.87	do	
odist Episcopal church	36 08.00	38 29.52	do	
regational church	36 15.01	38 09.72	do	
ersalist church	36 13.82	38 16.81	do	
leasant	41 30.25	29 45.78	do	
	29 55.62	12 36.97	do	
ist church	34 14.11	10 00.58	do	
eran church	34 42.32	12 22.97	do	
vegian Lutheran church	45 35.42	54 17.00	do	
Springs	57 15.42	08 08.93	do	
h	35 24.46	10 04.29	do	
urch	57 14.36	02 48.01	do	
	47 28.75	12 21.88	do	
d	32 51.49	05 57.45	do	
	42°-43°	90°-91°		
mark	42 30 03.19	90 13 37.24	do	
n	50 02.93	46 26.62	do	
lle, church steeple	57 43.77	07 45.27	do	
	57 45.60	07 51.44	do	
ollow church	41 29.60	40 49.75	do	
ore	58 28.53	40 45.85	do	
rch	58 55.87	39 06.79	do	
Grove	32 34.57	13 37.40	do	
	59 03.23	10 29.78	do	
n Station No. 1	45 45.28	25 30.22	do	
Point, Catholic church	51 34.35	11 06.10	do	
da	57 20.95	45 29.70	do	
ound	45 55.05	24 16.53	do	
lle, Normal School	44 09.47	28 48.52	do	
urg, Catholic church	34 32.96	13 45.99	do	
wa Mound	31 32.08	32 32.13	do	
ck	52 29.14	05 51.35	do	
ill	58 54.14	20 01.96	do	
lle church	58 25.01	25 53.54	do	
rner sec. 31, T. 1 N., R. 1 W., County.	30 26.40	26 44.20	L. S	Do.

MINNESOTA.

	47°-48°	89°-90°		
	° ′ ″	° ′ ″		
ar Knob	47 52 40.18	89 59 23.77	L. S	Final Rept.
	47°-48°	91°-92°		
ton	47 01 49.46	91 38 29.36	do	Do.
wteeth	23 19.02	10 15.79	do	Do.
ck	11 16.03	23 11.01	do	Do.
awteeth	22 19.08	11 43.63	do	Do.

MINNESOTA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	46°-47°	91°-92°		
	° ′ ″	° ′ ″		
Buchanan	46 56 28.07	91 47 19.82	L. S	Final Rept.
Lester	51 55.11	59 14.32	do	Do.
	46°-47°	92°-93°		
Minnesota Point, light-house	46 42 36.20	92 01 33.00	do	Do.
North base	45 27.89	04 43.26	do	Do.
Oneota	45 18.54	07 59.85	do	Do.
	45°-46°	93°-94°		
Mound View	45 05 30.53	93 10 02.11	C. & G. S	
	44°-45°	92°-93°		
Hampton	44 36 36.74	92 56 26.73	do	
Prescott	46 40.86	45 41.59	do	
Red Wing:				
Spire Catholic church	33 44.64	31 49.65	L. S	Do.
Astronomic monument				
Woodbury	54 51.97	56 38.02	C. & G. S	
	44°-45°	93°-94°		
Buck Hill	44 43 22.90	93 17 04.84	do	
Hopkins	55 10.44	27 25.90	do	
Marcotta	48 52.32	02 56.48	do	
Prospect Park	58 06.38	12 36.28	do	
Ramsey	59 19.21	00 18.97	do	
St. Paul:				
North base	59 42.44	09 51.34	do	
South base	54 59.81	09 52.02	do	
SE. corner of custom-house	56 43.00	05 34.00	do	
Wallace	54 19.55	05 12.14	do	
Washburn Home	54 46.49	16 36.07	do	

IOWA.

	42°-43°	90°-91°		
	° ′ ″	° ′ ″		
Sherrill Mound	42 36 17.21	90 47 33.37	C. & G. S	
	41°-42°	95°-96°		
Bluffs	41 14 32.44	95 50 35.43	Mo. R. C	Rept. '91.
Council	16 32.75	51 09.91	do	Do.
Crescent	21 09.58	52 16.73	do	Do.
Henton	06 04.82	49 00.85	do	Do.
Loveland	30 08.67	53 16.76	do	Do.
Taylor	41 13.15	56 31.47	do	Do.
	40°-41°	91°-92°		
Boardman	40 24 39.68	91 26 23.95	Miss. R. C	Rept. '84.
Hughes	24 38.06	24 09.13	do	Do.
Keokuk	24 34.70	22 44.81	do	Do.
Mrs. W. H. Sample's house	23 40.93	22 42.98	do	Rept. '88.
Presbyterian church spire	23 53.11	23 03.69	do	Do.
Unitarian church spire	23 49.32	22 47.62	do	Do.
Lower base	25 04.58	22 55.52	do	Rept. '84.
Upper base	25 43.51	23 16.34	do	Do.
Yellow Banks	24 24.65	29 20.13	do	Do.
	40°-41°	95°-96°		
Hamburg	40 33 20.06	95 37 40.83	Mo. R. C	Rept. '91.
McCracken	40 27.16	42 12.33	do	Do.
Pugh	46 33.28	44 22.71	do	Do.
Quarry	56 27.62	47 10.92	do	Do.
Thurman	50 55.04	45 34.40	do	Do.

MISSOURI

	40°-41°	91°-92°		
	° ′ ″	° ′ ″		
Canton	40 07 46.38	91 31 19.63	Miss. R. C	Rept. '88.
University	07 50.57	31 49.67	do	Rept. '84.
Congill	11 27.78	31 20.22	do	Do.
Fox River	21 34.82	35 20.87	do	Do.
Lagrange	02 46.88	29 58.45	do	Do.
	40°-41°	95°-96°		
Craig	40 13 00.05	95 22 43.21	Mo. R. C	Rept. '91.
Langdon	22 29.30	31 56.12	do	Do.
Napier	02 45.22	14 37.39	do	Do.

MISSOURI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			95°-96°				
	°	′	″	°	′	″		
	40	17	53.47	95	23	06.15	Mo. R. C	Rept. '91.
		26	57.68		34	07.44	do	Do.
	39°-40°			90°-91°				
ille	39	22	24.42	90	54	37.25	Miss. R. C	Rept. '84.
		01	38.90		44	57.54	do	Do.
		05	44.76		45	39.42	do	Do.
		25	03.24		59	16.52	do	Do.
er		15	15.73		49	37.99	do	Do.
	39°-40°			91°-92°				
al	39	41	19.73	91	19	23.43	do	Do.
vator, southeast gable		42	19.21		20	38.94	do	Rept. '88.
r		47	20.42		26	15.86	do	Rept. '84.
na		27	23.99		03	11.31	do	Do.
theast corner of high school ilding.		27	12.65		03	08.25	L. S	Final Rept.
theast corner of brick resi- nce on northwest corner oyes and Fourth streets.		27	15.20		03	07.40	do	Do.
e observing post in north- est corner of high school yard.		27	14.30		03	06.30	do	Do.
		52	20.76		30	06.58	Miss. R. C	Rept. '84.
use		36	28.96		12	53.24	do	Do.
ver		28	07.58		04	15.33	do	Do.
	39°-40°			94°-95°				
nia	39	53	21.07	94	53	54.10	Mo. R. C	Bull. 122.
		36	55.15		50	18.61	do	Do.
		27	41.08		58	00.81	do	Do
dence court-house		05	37.68		24	56.36	C. & G. S	
City :								
Patrick's church spire		06	08.04		35	19.19	do	
nsit								
or		38	55.29		56	01.70	Mo. R. C	Do.
nob		43	06.93		51	35.96	do	Do.
		29	58.30		59	39.89	do	Do.
		48	31.34		52	11.90	do	Do.
		27	37.49		04	47.07	G. S	Do.
rt, college spire		04	06.47		35	18.31	C. & G. S	
	39°-40°			95°-96°				
City	39	58	27.88	95	10	54.30	Mo. R. C	Do.
		33	22.79		01	57.13	do	Do.
ay		54	55.71		01	28.70	do	Do.
		55	18.39		07	33.29	do	Do.
	38°-39°			90°-91°				
	38	54	59.25	90	16	05.50	Miss. R. C	Rept. '84.
		05	12.82		12	48.87	do	Do.
		09	39.78		18	19.70	do	Do.
		00	26.00		04	54.83	do	Do.
se		56	43.38		25	43.16	do	Do.
		54	33.62		18	58.00	do	Do.
		30	39.64		17	32.83	do	Do.
n		51	29.42		09	02.01	do	Do.
		28	12.42		55	24.10	C. & G. S	
aneum		15	16.55		22	17.54	Miss. R. C	Do.
asylum		36	13.99		16	45.37	do	Do.
		24	32.46		43	59.70	C. & G. S	
ia		02	42.54		08	40.13	Miss. R. C	Do.
nee		24	23.78		19	36.79	do	Do.
ri River		48	39.97		07	49.21	do	Do.
on		54	00.65		13	09.85	do	Do.
on		27	57.41		31	59.53	C. & G. S	
		55	10.84		20	37.93	Miss. R. C	Do.
		55	47.03		22	33.65	do	Do.
n		45	30.68		11	18.10	do	Do.
is, Washington University		38	03.00		12	17.00	C. & G. S	
		50	48.33		07	22.12	Miss. R. C	Do.
ipe		40	13.59		12	31.51	do	Do.
		52	57.31		11	50.73	do	Do.
r Springs		19	41.09		22	31.84	do	Do.
in		48	04.79		08	59.63	do	Do.
ollow		27	05.35		17	37.08	do	Do.
s		52	05.69		10	38.65	do	Do.
		54	27.33		14	29.76	do	Do.
ase		56	14.28		26	58.85	do	Do.
d		59	18.39		44	19.22	do	Do.
	38°-39°			91°-92°				
	38	26	22.93	91	16	09.42	C. & G. S	
		27	01.78		35	48.40	do	
		27	51.82		03	45.43	do	

MISSOURI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			91°-92°				
	°	'	"	°	'	"		
Pilot	38	20	15.99	91	47	55.15	C. & G. S	
Winter		27	46.12		26	02.37	do	
	38°-39°			92°-93°				
Hughes	38	26	01.36	92	55	50.61	do	
Wright		46	01.63		22	28.27	Mo. R. C	Bull. 122.
	38°-39°			93°-94°				
Caldwell	38	34	10.21	93	45	21.08	C. & G. S.	
Cook Knob, pole in cupola in Cook's ice house.		52	02.06		31	30.45	do	
Hazel Hill		53	46.08		45	05.57	do	
Heard		43	01.28		12	24.88	do	
High Point Tebo		34	39.15		34	18.80	do	
Kendrick		39	43 83		25	57.98	do	
Knob Noster		46	40.35		33	05.70	do	
Lamonte, Campbellite church spire		46	44.25		25	22.98	do	
Normal		45	37.89		44	15.08	do	
Schnackenburg		29	56.63		11	26.18	do	
Sedalia, spire		42	26.77		13	36.00	do	
	38°-39°			94°-95°				
Baker, Kingsville	38	45	41.91	94	04	11.78	do	
Belton, South Methodist church spire		48	37.64		31	48.65	do	
Bowler		53	20.98		23	38.30	do	
Butler, barn cupola		46	51.42		25	59.85	do	
Berry, Belton		49	18.89		33	32.45	do	
Chapel Hill		54	52.14		08	27.27	do	
Fulton, Harrisonville		38	48.46		18	33.07	do	
Hutton Mound		32	56.24		10	48.82	do	
North Mound		20	51.45		17	13.20	G. S	Do.
Thornton		50	10.25		14	45.83	do	Do.
Corner Ts. 42 and 43, State line		28	43.66		36	44.57	do	Do.
Corner Ts. 40 and 41, Rs. 30 and 31		18	29.52		17	28.44	do	Do.
Corner Ts. 19 and 20, State line		20	47.52		36	45.42	do	Do.
Corner Ts. 17 and 18, State line		31	11.86		36	42.39	do	Do.
	37°-38°			89°-90°				
Backbone	37	44	48.74	89	39	53.09	Miss. R. C	Rept. '84.
Bowles		01	02.61		12	31.18	do	Do.
Cape Girardeau		18	27.01		31	08.86	do	Rept. '88.
Normal school		18	45.14		31	53.17	do	Do.
Cape Lecroix		14	53.51		28	05.76	do	Rept. '84.
Commerce		08	27.52		26	13.19	do	Do.
Floral		20	50.38		28	25.53	do	Do.
Grand Chain		13	02.59		28	27.61	do	Do.
Hofner		10	05.44		27	06.25	do	Do.
Indian Creek		30	59.60		30	24.06	do	Do.
Killion		48	10.73		47	27.73	do	Do.
Lower base		49	28.52		43	34.53	do	Do.
Missouri Sister		04	41.99		17	00.56	do	Do.
Moccasin Springs		26	28.54		27	13.57	do	Do.
North base		14	26.69		27	49.10	do	Do.
Rowse		03	34.67		15	27.87	do	Do.
Rozier		51	50.03		54	54.35	do	Do.
Silica		36	41.72		31	11.11	do	Do.
South base		13	49.17		28	07.25	do	Do.
Taylor		02	51.93		14	15.28	do	Do.
Uncle Joe		11	51.36		28	07.18	do	Do.
Upper base		50	40.41		45	12.02	do	Do.
Vause		54	48.43		59	20.73	do	Do.
	37°-38°			90°-91°				
St. Genevieve, church spire	37	58	45.02	90	02	49.75	do	Rept. '88.
Bolivar:	37°-38°			93°-94°				
Astronomical pier	37	36	35.22	93	24	47.68	G. S	Bull. 49.
Court-house dome		36	53.38		24	38.00	do	Do.
Pinnacle of schoolhouse		37	01.87		24	47.75	do	Do.
Methodist church spire		36	58.28		24	34.33	do	Do.
Southwest pinnacle Southwest Baptist College.		36	31.34		24	44.78	do	Do.
North Springfield:								
Astronomical pier		13	15.96		17	17.58	do	Do.
Ozark Hotel, flagstaff		13	51.56		17	16.69	do	Do.
Waterworks, flagstaff		14	03.26		17	35.36	do	Do.
Catholic church spire		13	42.01		17	05.25	do	Do.
Drury College chapel, spire		13	06.66		17	16.74	do	Do.
Center sec. 13, T. 29 N., R. 22 W		13	10.16		17	08.59	do	Do.
SW. corner sec. 7, T. 29 N., R. 21 W		13	35.95		16	34.74	do	Do.
SW. corner T. 30 N., R. 21 W		16	30.65		17	50.62	do	Do.
¼ sec. corner W. side of sec. 1, T. 29 N., R. 22 W.		16	14.32		17	34.33	do	Do.
SW. corner sec. 1, T. 33 N., R. 23 W		36	47.93		24	44.95	do	Do.

MISSOURI—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	37°-38°			93°-94°				
	°	′	″	°	′	″		
rner T. 33 N., R. 23 W	37	37	38.25	93	23	35.02	G. S	Bull. 49.
rner on S. side sec. 12, T. 33 N., W.		36	48.25		25	31.45	do	Do.
	36°-37°			92°-93°				
	36	33	32.76	92	58	48.69	do	Bull. 122.
ond		45	37.92		59	59.53	do	Do.
	36°-37°			93°-94°				
	36	39	13.89	93	17	45.27	do	Do.
field		43	43.96		54	48.91	do	Do.
r		39	56.00		42	32.43	do	Do.
nob		32	46.34		32	46.49	do	Do.
		36	34.49		08	47.74	do	Do.

NORTH DAKOTA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	48°-49°			102°-103°				
	°	′	″	°	′	″		
lies High	48	02	19.38	102	41	31.33	Mo. R. C	Rept. '91.
rn		04	15.94		44	52.26	do	Do.
ll		10	27.76		57	18.59	do	Do.
utte		05	24.41		52	40.07	do	Do.
Hill		02	54.45		34	58.63	do	Do.
erry		10	00.23		53	15.92	do	Do.
Earth		07	44.12		40	43.08	do	Do.
	48°-49°			103°-104°				
nds	48	03	27.61	103	27	15.48	do	Do.
		01	01.49		58	03.31	do	Do.
		03	27.28		32	06.26	do	Do.
ill		04	35.48		12	47.48	do	Do.
		02	00.86		34	53.87	do	Do.
		04	26.78		21	12.67	do	Do.
Cut		06	00.05		44	57.51	do	Do.
		09	38.38		12	56.24	do	Do.
ation		00	05.75		47	25.34	do	Do.
		05	21.90		37	36.16	do	Do.
o		06	46.02		03	57.17	do	Do.
n		02	16.67		53	53.54	do	Do.
on		09	19.57		34	47.87	do	Do.
	47°-48°			100°-101°				
	47	09	08.89	100	52	19.96	do	Do.
Butte		03	00.07		56	09.54	do	Do.
urn		18	04.45		59	39.14	do	Do.
		00	45.43		49	25.10	do	Do.
	47°-48°			101°-102°				
ld	47	33	40.56	101	49	39.49	do	Do.
wa		33	06.02		40	32.98	do	Do.
arbor		29	51.23		21	16.24	do	Do.
		30	16.36		41	26.65	do	Do.
el		31	21.44		35	06.96	do	Do.
meridian		29	39.66		46	46.49	do	Do.
k		25	00.43		25	41.67	do	Do.
an		18	33.22		26	22.75	do	Do.
uist		20	36.06		18	25.19	do	Do.
n Lake		14	55.88		08	38.54	do	Do.
		12	56.94		02	49.83	do	Do.
on		32	12.06		21	53.01	do	Do.
n		16	24.60		22	44.04	do	Do.
son		35	46.98		27	08.57	do	Do.
herm		18	46.31		16	32.32	do	Do.
w		29	01.42		28	44.72	do	Do.
	47°-48°			102°-103°				
	47	30	17.60	102	02	55.77	do	Dc.
		33	39.64		11	37.30	do	Do.
ndence		43	12.26		20	25.79	do	Do.
Creek		45	33.30		33	30.34	do	Do.
River		58	29.89		32	40.59	do	Do.
Missouri		37	21.25		18	29.59	do	Do.
ry		44	32.80		29	12.89	do	Do.
n		38	09.18		13	35.72	do	Do.
idge		52	14.17		41	47.32	do	Do.
Mountain		51	19.75		40	27.67	do	Do.
		35	11.70		01	36.71	do	Do.
Ridge		50	12.49		31	00.20	do	Do.
		45	58.77		14	55.11	do	Do.

NORTH DAKOTA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	47°-48° ° ′ ″	103°-104° ° ′ ″		
East base	47 59 49.98	103 56 52.94	Mo. R. C	Rept. '91.
Glass Bluff	57 01.14	55 45.40	do	Do.
Lagoon	58 47.17	28 37.08	do	Do.
Plum	59 43.48	21 53.65	do	Do.
West base	59 36.26	59 39.28	do	Do.
	46°-47°	100°-101°		
Battle Creek	46 08 44.72	100 39 07.00	do	Do.
Beaver Creek	17 08.40	31 30.62	do	Do.
Bismarck	49 12.34	45 08.11	do	Do.
Cannon Ball	23 55.25	38 19.27	do	Do.
Cathead	06 52.45	32 43.38	do	Do.
Fort Abraham Lincoln	46 10.00	50 57.00	Engr. Corps	Rept. '75.
Fort Rice	31 47.13	41 12.47	Mo. R. C	Rept. '91.
Fort Yates	05 59.44	38 07.42	do	Do.
Gayton	23 44.04	31 34.64	do	Do.
Givens	19 54.15	34 54.54	do	Do.
Glencoe	36 15.59	30 05.23	do	Do.
Harmon	58 40.13	57 15.11	do	Do.
Kayhall	44 03.89	40 33.96	do	Do.
Lincoln	46 12.23	51 03.22	do	Do.
Little Beaver	12 11.61	32 44.64	do	Do.
Little Hart	41 56.32	49 09.74	do	Do.
Mandan	51 08.07	55 05.04	do	Do.
Marysville	51 06.89	48 06.99	do	Do.
McIntyre	28 27.70	32 11.73	do	Do.
McRay	00 54.01	30 40.28	do	Do.
North base	48 10.89	48 14.58	do	Do.
Riverside	37 22.72	43 54.03	do	Do.
South base	45 34.60	47 00.60	do	Do.
Sperry	57 05.97	52 19.87	do	Do.
Van Solen	16 03.91	37 28.84	do	Do.
Winona	03 55.20	33 02.12	do	Do.
	45°-46°	100°-101°		
Fire Heart	45 59 39.55	100 34 41.14	do	Do.

SOUTH DAKOTA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46° ° ′ ″	100°-101° ° ′ ″		
Ashley	45 37 45.15	100 26 16.76	Mo. R. C	Rept. '91.
Aske	33 46.22	22 53.90	do	Do.
Bunker Hill	06 21.61	14 34.37	do	Do.
Bennett	24 00.83	13 28.60	do	Do.
Blue Blanket	29 20.96	24 48.56	do	Do.
Blume	41 19.45	20 39.18	do	Do.
Box Elder	46 05.12	24 20.98	do	Do.
Campbell	41 08.63	14 47.46	do	Do.
Charger	03 20.84	21 00.95	do	Do.
Curlew	25 18.25	20 20.10	do	Do.
Doerschlag	58 01.94	27 14.98	do	Do.
Fox Island	28 29.75	18 10.20	do	Do.
Grand River	32 47.94	29 49.28	do	Do.
Kirkland	46 07.63	17 31.17	do	Do.
La Grace	53 49.18	23 27.76	do	Do.
Le Beau	19 28.54	17 22.61	do	Do.
Martin	55 43.20	32 47.35	do	Do.
McKinley	20 12.18	12 33.97	do	Do.
Roth	36 11.35	20 48.81	do	Do.
Scranton	14 36.96	13 32.42	do	Do.
St. Benedict	50 30.75	30 54.23	do	Do.
St. Stephen	12 46.10	19 01.65	do	Do.
	44°-45°	99°-100°		
Big Bend	44 13 46.16	99 37 31.62	do	Do.
Burnt Ridge	01 19.73	38 53.90	do	Do.
Cedar River	05 42.40	54 28.06	do	Do.
Chapelle Creek	16 29.61	54 01.86	do	Do.
Neck	08 15.29	35 36.32	do	Do.
Reynolds	10 45.69	46 09.14	do	Do.
Fort Thompson	06 02.46	26 44.92	do	Do.
Wolf Creek	01 57.01	18 10.48	do	Do.
	44°-45°	100°-101°		
Artichoke	44 50 27.93	100 21 19.01	do	Do.
Bad River	19 50.86	20 39.25	do	Do.
Barth	20 38.89	14 03.58	do	Do.

SOUTH DAKOTA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	44°-45°	100°-101°		
	° ′ ″	° ′ ″		
ill	44 25 39.58	100 27 23.68	Mo. R. C	Rept. '91.
y	21 54.71	18 19.73	do	Do.
e	20 46.24	17 07.56	do	Do.
	46 43.75	25 45.40	do	Do.
and	18 24.37	14 03.51	do	Do.
	24 31.84	31 20.83	do	Do.
	31 56.36	38 10.84	do	Do.
ity	59 15.11	18 07.48	do	Do.
	22 04.98	24 14.87	do	Do.
nett	41 38.25	41 46.38	do	Do.
rge	14 21.71	02 04.22	do	Do.
	29 28.34	29 24.58	do	Do.
	18 05.28	02 08.00	do	Do.
s	17 15.80	07 21.06	do	Do.
	54 47.75	26 49.60	do	Do.
	20 15.48	08 45.29	do	Do.
	22 50.28	20 26.44	do	Do.
	19 32.50	18 01.60	do	Do.
land	51 37.13	34 44.83	do	Do.
n	19 26.16	05 16.95	do	Do.
r	59 26.12	27 41.83	do	Do.
itte	25 36.03	21 45.15	do	Do.
ll	28 19.00	23 57.26	do	Do.
	41 54.74	29 06.48	do	Do.
se	21 14.97	19 47.76	do	Do.
	44°-45°	103°-104°		
te	44 28 34.40	103 25 08.90	G. S	Bull. 122.
	18 12.90	05 26.80	do	Do.
	14 41.40	43 41.10	do	Do.
d, post-office	22 34.00	43 18.60	L. S	Final Rept.
	05 20.30	03 32.30	G. S	Bull. 122.
e	07 04.00	04 35.50	do	Do.
	09 53.80	06 20.10	do	Do.
t	13 55.80	21 40.50	do	Do.
stronomical pier	04 45.24	12 59.28	do	Do.
	03 07.10	14 16.50	do	Do.
e	07 09.20	10 29.10	do	Do.
	06 53.70	14 12.00	do	Do.
	43°-44°	98°-99°		
	43 03 03.67	98 41 30.51	Mo. R. C	Rept. '91.
	18 02.50	51 58.75	do	Do.
	08 43.72	37 39.33	do	Do.
ad	13 20.61	56 05.37	do	Do.
	12 20.63	48 26.42	do	Do.
ne	06 35.91	50 04.30	do	Do.
wan	03 52.46	29 21.42	do	Do.
	43°-44°	99°-100°		
Creek	43 59 10.55	99 28 45.86	do	Do.
	30 51.66	15 26.56	do	Do.
	56 24.00	19 42.32	do	Do.
	23 22.68	01 31.08	do	Do.
n	23 46.97	12 49.96	do	Do.
	47 06.18	27 05.15	do	Do.
rlain	47 23.66	19 17.70	do	Do.
	20 38.83	08 30.92	do	Do.
	27 52.74	19 56.52	do	Do.
okout	53 29.15	23 38.34	do	Do.
n	16 25.20	02 18.26	do	Do.
	26 46.83	07 42.65	do	Do.
	37 49.46	30 13.57	do	Do.
l	51 12.80	17 24.94	do	Do.
	31 47.39	24 37.69	do	Do.
	38 56.08	19 37.74	do	Do.
	43°-44°	102°-103°		
on Butte	43 55 07.00	102 58 42.50	G. S	Bull. 122.
	43°-44°	103°-104°		
	43 25 08.50	103 37 07.00	do	Do.
e	35 52.60	06 43.50	do	Do.
	45 56.44	36 17.30	Engr. Corps	Rept. '78.
	12 21.52	30 00.00	G. S	Bull. 122.
	30 51.00	22 03.40	do	Do.
Peak	51 59.60	31 27.30	do	Do.
ne	00 04.50	16 02.70	do	Do.
	14 35.00	11 00.50	do	Do.

NEBRASKA.

Name.	Latitude.			Longitude.			Authority.	Reference.
	42°-43°			96°-97°				
	°	′	″	°	′	″		
Baird	42	20	59.31	96	30	14.14	Mo. R. C	Rept. '91.
Blackbird		04	45.93		17	54.86	do	Do.
Emerson		30	04.95		28	06.87	do	Do.
Grant		10	32.11		00	33.26	do	Do.
Hall		36	42.45		30	25 34	do	Do.
Hedges		19	08.27		08	07.10	do	Do.
Ionia		39	19.78		46	02.25	do	Do.
Johnson		49	07.40		41	56.12	do	Do.
Round Cap		29	25.68		35	37.66	do	Do.
Ryan		42	14.28		53	02.74	do	Do.
Sargeants		24	31.50		21	04.78	do	Do.
Spirit Mound		52	26.44		57	31.90	do	Do.
Triloba		33	30.29		40	02.36	do	Do.
Westfield		41	13.31		33	21.77	do	Do.
Winnebago		15	57.93		22	27.17	do	Do.
	42°-43°			97°-98°				
Bon Homme	42	52	20.47	97	40	19.47	do	Do.
Bow Creek		46	03.82		07	32.98	do	Do.
Covell		49	53.77		56	31.20	do	Do.
Herrick		47	59.94		39	10.81	do	Do.
Kelley		47	50.98		57	26.60	do	Do.
Lakeport		53	20.24		33	08.55	do	Do.
Lost Creek		46	56.68		54	03.94	do	Do.
Niobrara		44	01.46		57	49.24	do	Do.
North base		47	54.41		55	33.18	do	Do.
Pit		47	50.29		31	02.84	do	Do.
Santee		47	58.11		47	10.61	do	Do.
Schmidt		48	15.38		19	48.03	do	Do.
South base		46	01.81		57	24.49	do	Do.
Springfield		53	07.24		50	34.33	do	Do.
Welby		55	57.63		19	00.38	do	Do.
	42°-43°			98°-99°				
Arneson	42	48	29.35	98	02	54.14	do	Do.
Bruce		53	45.01		24	37.50	do	Do.
Chouteau		52	17.12		08	37.97	do	Do.
Conger		55	50.48		13	42.09	do	Do.
Harrison		57	11.06		34	47.52	do	Do.
Ponca		46	47.56		12	29.06	do	Do.
Ward		45	07.05		06	25.15	do	Do.
	42°-43°			103°-104°				
Camp Robinson, flagstaff	42	39	48.33	103	27	45.00	Engr. Corps.	Rept. '78.
	41°-42°			95°-96°				
Bellevue	41	09	47.79	95	53	57.06	do	Bull. 122.
Bluffs		14	32.44		50	35.43	do	Rept. '91.
Council		16	32.75		51	09.91	do	Do.
Crescent		21	09.58		52	16.73	do	Do.
Douglas		23	40.89		58	33.65	do	Do.
Henton		06	04.82		49	00.85	do	Do.
High School		15	36.11		56	38.14	do	Do.
Mormon		48	52.12		59	43.85	do	Do.
Omaha		16	50.46		57	33.27	do	Do.
Platte		02	08.56		53	55.42	Mo. R. C	Bull. 122.
Taylor		41	13.10		56	31.48	do	Rept. '91.
U. S. C. and G		15	33.94		56	37.22	do	Do.
	41°-42°			96°-97°				
Bench	41	33	11.12	96	07	45.58	do	Do.
Blair		31	05.32		07	05.09	do	Do.
East base		36	49.41		06	50.33	do	Do.
Herman		38	04.65		12	24.07	do	Do.
Sandig		56	32.87		14	31.41	do	Do.
Tekamah		46	16.27		13	34.99	do	Do.
West		36	49.19		09	40.18	do	Do
	41°-42°			100°-101°				
North Platte, astronomical monument.	41	08	18.33	100	45	53.14	Wheeler	Final Rept.
	41°-42°			102°-103°				
Fort Sidney, astronomical monument.	41	08	36.75	102	58	13.32	do	Do.
	41°-42°			103°-104°				
Bushnell, transit	41	13	54.00	103	52	56.25	C. & G. S	Rept. '84.
	40°-41°			95°-96°				
Arago	40	08	13.84	95	26	39.51	Mo. R. C	Rept. '91.
Brownville		24	30.39		39	36.59	do	Do.
Calumet		53	40.80		53	21.02	do	Do.
City		36	32.01		47	59.14	do	Do.

NEBRASKA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	40°-41°			95°-96°				
	°	′	″	°	′	″		
	40	14	37.26	95	31	16.01	Mo. R. C	Rept. '91.
		49	07.05		52	05.56	do	Do.
		01	08.48		20	59.11	do	Do.
		39	16.90		49	03.08	do	Do.
		28	10.98		42	11.39	do	Do.
in		16	44.45		34	18.72	do	Do.
	40°-41°			97°-98°				
e Kansas and Nebraska	40	00	12.52	97	55	54.66	G. S	Bull. 122.

KANSAS.

Name.	Latitude.			Longitude.			Authority.	Reference.
	39°-40°			94°-95°				
	°	′	″	°	′	″		
n	39	41	56.86	94	58	59.13	Mo. R. C	Rept. '91.
ia		53	21.07		53	54.10	do	Do.
avenworth		21	19.12		54	51.84	Engr. Corps	Do.
		50	46.35		59	45.32	Mo. R. C	Do.
		36	55.15		59	18.61	do	Do.
		27	41.08		58	00.81	do	Do.
r		38	55.29		56	01.70	do	Do.
o		24	22.13		58	25.79	do	Do.
Knob		43	06.93		51	35.96	do	Do.
		29	58.30		59	39.89	do	Do.
n		22	16.45		55	52.67	do	Do.
		48	31.34		52	11.90	do	Do.
a		45	09.89		57	07.31	do	Do.
		24	10.55		53	45.96	do	Do.
	39°-40°			95°-96°				
	39	14	44.10	95	50	10.20	G. S	Bull. 122.
n		35	42.56		05	53.20	Mo. R. C	Rept. '91.
		22	20.01		33	13.35	G. S	Bull. 122.
		17	13.39		36	25.64	do	Do.
		02	37.37		00	05.19	C. & G. S	Do.
City		58	27.88		10	54.30	Mo. R. C	Rept. '91.
		38	54.56		02	55.52	do	Do.
		33	22.79		01	57.13	do	Do.
ton		00	06.17		24	21.74	G. S	Bull. 122.
		53	26.71		10	04.96	Mo. R. C	Rept. '91.
		11	54.86		34	40.64	G. S	Bull. 122.
		51	28.21		05	13.09	Mo. R. C	Rept. '91.
n		07	11.39		28	57.02	G. S	Bull. 122.
y		54	55.71		01	28.70	Mo. R. C	Rept. '91.
ls		26	56.54		01	07.91	do	Do.
e		10	24.10		19	57.30	G. S	Bull. 122.
		06	56.78		20	53.40	do	Do.
		55	18.39		07	33.29	Mo. R. C	Rept. '91.
tomie		24	52.00		50	48.21	G. S	Bull. 122.
l		19	26.47		42	48.38	do	Do.
eek		15	56.26		31	17.35	do	Do.
rhorn		13	57.05		41	41.87	do	Do.
		31	34.23		06	02.24	Mo. R. C	Rept. '91.
		21	19.29		57	35.63	G. S	Bull. 122.
Cloud		57	39.99		16	25.02	Mo. R. Co	Rept. '91.
ill		05	02.12		12	35.59	G. S	Bull. 122.
er sec. 21, T. 7, R. 14		25	15.38		50	54.35	do	Do.
ner sec. 1, T. 11, R. 17		07	00.46		28	59.40	do	Do.
ner sec. 15, T. 12, R. 18		00	06.13		24	33.79	do	Do.
ner sec. 25, T. 9, R. 15		13	56.07		42	00.24	do	Do.
rner sec. 26, T. 8, R. 15		19	34.45		43	07.45	do	Do.
rner sec. 27, T. 9, R. 14		14	47.01		49	55.40	do	Do.
ner sec. 19, T. 10, R. 19		10	25.77		19	43.14	do	Do.
ner sec. 7, T. 11, R. 19		07	03.40		20	42.15	do	Do.
ner sec. 6, T. 12, R. 21		02	42.60		00	03.84	do	Do.
rner sec. 11, T. 9, R. 16		17	23.86		36	26.06	do	Do.
rner sec. 15, T. 8, R. 13		21	45.40		57	36.61	do	Do.
er sec. 16, T. 9, R. 17		16	05.63		30	57.47	do	Do.
er sec. 20, T. 11, R. 20		04	54.57		12	21.73	do	Do.
er sec. 7, T. 8, R. 17		22	12.42		33	12.80	do	Do.
corner sec. 12, T. 10, R. 16		11	44.71		34	46.93	do	Do.
	39°-40°			96°-97°				
	39	29	42.52	96	19	07.22	do	Do.
		28	48.46		26	44.12	do	Do.
lville		22	53.20		47	19.91	do	Do.
lle		22	30.40		20	48.35	do	Do.
g		26	19.60		32	45.05	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	39°-40°			96°-97°				
	°	'	"	°	'	"		
Randolph	39	32	02.03	96	44	44.33	G. S	Bull. 122.
Springside		32	55.57		30	28.01	do	Do.
St. Marys		16	31.60		06	15.10	do	Do.
Stockdale		20	44.26		32	01.20	do	Do.
SE. corner sec. 29, T. 6, R. 10		29	39.48		18	50.25	do	Do.
S. ¼ sec. 17, T. 7, R. 8		26	12.84		32	51.35	do	Do.
SW. corner sec. 5, T. 8, R. 6		22	47.20		47	34.08	do	Do.
NE. corner sec. 6, T. 7, R. 9		28	48.65		26	40.66	do	Do.
N. ¼ corner sec. 7, T. 8, R. 10		22	41.20		20	32.57	do	Do.
N. ¼ corner sec. 15, T. 6, R. 6		32	17.77		44	44.30	do	Do.
NW. corner sec. 17, T. 9, R. 12		16	33.52		06	35.33	do	Do.
NW. corner sec. 21, T. 8, R. 8		20	59.72		32	16.32	do	Do.
	39°-40°			97°-98°				
Butler	39	15	25.88	97	15	33.67	do	Do.
Concordia		31	28.03		40	34.64	do	Do.
Frey		01	31.84		10	24.56	do	Do.
Jamestown		39	23.77		50	40.98	do	Do.
Minersville		40	10.09		41	58.48	do	Do.
Monument		13	33.24		30	05.41	do	Do.
Renshawe		33	37.45		11	47.30	do	Do.
Scottsville		32	26.99		57	22.31	do	Do.
Sulphur Springs		24	36.77		30	42.37	do	Do.
Table Mound		18	44.74		16	36.81	do	Do.
Thompson		04	19.49		49	45.44	C. & G. S	
Vine Creek		06	11.06		23	23.18	do	
Wayne		41	45.81		30	20.34	G. S	Do.
Wilmer		07	20.93		02	22.80	do	Do.
Center corner sec. 11, T. 12, R. 2		01	31.95		10	33.73	do	Do.
NW. corner sec. 13. T. 11, R. 1		06	15.63		23	23.79	do	Do.
SE. corner sec. 1, T. 11, R. 3		07	10.80		02	13.08	do	Do.
W. corner sec. 36, T. 9, R. 2 W		13	27.80		30	12.60	do	Do.
One-fourth corner secs. 24 and 19, T. 9, Rs. 1 and 2 E.		15	27.02		15	32.88	do	Do.
SE. corner sec. 35, T. 8, R. 1 E		18	29.10		16	36.70	do	Do.
S. ¼ corner sec. 26, T. 7, R. 2		24	35.86		30	43.88	do	Do.
N. ¼ corner sec. 20, T. 6, R. 3		31	34.49		40	34.29	do	Do.
S. ¼ corner sec. 11, T. 6, R. 6		32	24.73		57	25.56	do	Do.
E. corner sec. 11, T. 6, R. 6		32	38.69		09	16.32	do	Do.
S. ¼ corner sec. 35, T. 4, R. 5		39	17.65		50	50.43	do	Do.
S. ¼ corner sec. 30, T. 4, R. 3		40	10.17		41	50.37	do	Do.
NE. corner sec. 23, T. 4, R. 2 W		41	59.00		29	46.70	do	Do.
	39°-40°			98°-99°				
Blue Hill	39	20	34.43	98	19	01.13	do	Do.
Cemetery		35	51.53		10	25.06	do	Do.
Church		20	52.77		06	06.93	do	Do.
Hardilee		50	57.55		57	03.13	do	Do.
Lawrence Creek		31	17.82		51	28.82	do	Do.
Lincoln		05	34.63		05	56.86	C. & G. S	
Meade Ranch or Tree Will		13	32.79		32	31.61	do	
Old well		36	47.61		34	00.86	G. S	Do.
Pointed Hill		44	21.20		05	42.48	do	Do.
School		39	23.13		42	38.01	do	Do.
Tipton		21	38.54		31	57.62	do	Do.
Waldo		10	00.77		49	52.37	C. & G. S	
Corner secs. 15, 16, 21, 22, T. 8, R. 7		21	04.73		05	50.81	G. S	Do.
E. ¼ corner sec. 15, T. 8, R. 11		21	39.38		31	38.08	do	Do.
W. ¼ corner sec. 23, T. 6, R. 14		31	09.68		51	32.13	do	Do.
SW. corner sec. 24, T. 5, R. 8		35	51.40		10	32.90	do	Do.
SE. corner sec. 16, T. 5, R. 11		36	44.32		33	40.50	do	Do.
N. ¼ corner sec. 3, T. 4, R. 7		44	32.04		05	47.87	do	Do.
W. ¼ corner sec. 30, T. 2, R. 14		51	06.93		57	15.75	do	Do.
	39°-40°			99°-100°				
Blue Mound	39	50	17.51	99	09	21.08	do	Do.
Densmore		35	22.38		41	51.48	do	Do.
Engstrom		34	43.59		00	06.57	do	Do.
Plaster Mound		46	18.67		30	21.19	do	Do.
Rock Mound		35	41.72		28	22.30	do	Do.
Stahl		44	00.81		49	03.34	do	Do.
Twin Mound		36	52.73		18	49.82	do	Do.
Windmill		33	02.28		54	10.34	do	Do.
N. ¼ corner sec. 34, T. 5, R. 15		35	01.40		00	03.34	do	Do.
NW. corner sec. 28, T. 5, R. 19		35	52.18		28	41.34	do	Do.
S. ¼ corner sec. 14, T. 5, R. 18		36	44.73		19	06.61	do	Do.
SE. corner sec. 5, T. 4, R. 22		43	38.57		48	55.11	do	Do.
N. ¼ corner sec. 32, T. 2, R. 16		50	39.66		09	04.78	do	Do.
	39°-40°			100°-101°				
Lenora	39	34	40.17	100	02	06.47	do	Do.
Wakeman		42	08.15		00	41.09	do	Do.
SW. corner sec. 33, T. 5, R. 24		34	05.50		02	23.00	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			94°-95°				
	°	′	″	°	′	″		
	38	28	52.14	94	41	24.12	G. S	Bull. 122.
Methodist Episcopal church		57	49.10		44	20.00	do	Do.
und		30	30.94		36	54.35	do	Do.
		20	49.60		56	26.04	do	Do.
nie, insane asylum		30	50.86		56	19.64	do	Do.
Mound		20	00.55		37	15.90	do	Do.
s. 42 and 43, State line		28	43.66		36	44.57	do	Do.
s. 40 and 41, Rs. 30 and 31		18	29.52		17	28.44	do	Do.
s. 19 and 20, Rs. 22 and 23		20	48.72		55	02.97	do	Do.
s. 19 and 20, State line		20	47.52		36	45.42	do	Do.
s. 18 and 19, Rs. 24 and 25		26	02.63		41	43.13	do	Do.
s. 17 and 18, Rs. 22 and 23		31	16.29		55	03.33	do	Do.
s. 17 and 18, State line		31	11.86		36	42.39	do	Do.
	38°-39°			95°-96°				
	38	23	26.62	95	45	13.55	do	Do.
und		54	20.72		10	53.95	do	Do.
		25	10.89		56	56.69	do	Do.
		22	48.40		38	11.72	do	Do.
, cross on church		23	13.58		27	09.65	do	Do.
		27	26.86		46	25.60	do	Do.
e University		57	30.48		14	36.32	do	Do.
		27	15.04		27	30.12	do	Do.
d, cupola of church		24	14.64		15	10.71	do	Do.
und		20	09.52		31	10.36	do	Do.
		30	28.72		40	19.64	do	Do.
utch college		22	00.30		13	00.18	do	Do.
oolhouse		25	07.59		51	29.45	do	Do.
		30	37.34		08	50.00	do	Do.
		23	57.08		03	51.80	do	Do.
er sec. 36, T. 12, R. 19		57	30.06		14	28.13	do	Do.
er sec. 22, T. 13, R. 20		54	00.74		11	08.03	do	Do.
s. 20 and 21, Rs. 19 and 20		15	39.10		14	54.33	do	Do.
s. 19 and 20, Rs. 19 and 20		20	52.61		14	53.47	do	Do.
s. 19 and 20, Rs. 16 and 17		20	53.15		34	53.15	do	Do.
s. 19 and 20, Rs. 14 and 15		20	51.74		48	07.69	do	Do.
s. 18 and 19, Rs. 17 and 18		26	06.60		28	14.58	do	Do.
s. 18 and 19, Rs. 14 and 15		26	05.34		48	06.91	do	Do.
s. 18 and 19, Rs. 13 and 14		26	05.58		54	45.04	do	Do.
s. 17 and 18, Rs. 15 and 16		31	23.42		41	29.02	do	Do.
s. 17 and 18, Rs. 20 and 21		31	19.21		08	15.30	do	Do.
	38°-39°			96°-97°				
	38	28	52.41	96	28	21.28	do	Do.
anch		26	28.24		37	03.25	do	Do.
Mound		21	10.91		04	08.52	do	Do.
ood Falls, cupola of court-		22	18.47		32	28.30	do	Do.
, cupola of State normal		24	50.96		10	47.52	do	Do.
		15	57.32		54	53.86	do	Do.
ound		18	57.82		24	11.58	do	Do.
		16	12.26		40	49.00	do	Do.
		10	30.13		53	46.84	do	Do.
		30	34.76		01	43.20	do	Do.
		09	13.46		59	58.46	do	Do.
		28	48.56		18	08.04	do	Do.
		19	34.46		37	38.01	do	Do.
s		21	52.57		43	56.30	do	Do.
s. 20 and 21, Rs. 5 and 6		15	45.68		49	07.73	do	Do.
s. 20 and 21, Rs. 6 and 7		15	45.39		42	29.86	do	Do.
s. 17 and 18, Rs. 12 and 13		31	21.70		01	24.07	do	Do.
s. 18 and 19, Rs. 7 and 8		26	11.61		35	50.45	do	Do.
s. 19 and 20, Rs. 6 and 7		20	57.83		42	30.25	do	Do.
s. 19 and 20, Rs. 12 and 13		20	54.26		01	25.50	do	Do.
s. 19 and 20, Rs. 7 and 8		20	57.74		35	52.40	do	Do.
s. 20 and 21, Rs. 4 and 5		15	45.45		55	45.11	do	Do.
s. 17 and 18, Rs. 8 and 9		31	23.60		27	51.51	do	Do.
	38°-39°			97°-98°				
	38	10	32.99	97	16	03.24	do	Do.
ttle		08	52.10		33	43.00	do	Do.
l		13	28.69		10	06.06	do	Do.
		04	24.78		39	51.21	do	Do.
		14	27.16		01	23.46	do	Do.
		08	30.86		25	38.62	do	Do.
und		48	34.58		30	42.85	C. & G. S	
		08	39.43		47	17.01	G. S	Do.
		06	44.73		11	58.24	do	Do.
		02	58.56		20	40.06	do	Do.
		10	09.10		20	09.84	do	Do.
		03	30.50		29	40.05	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	°	′	″	°	′	″		
	38°-39°			97°-98°				
Sand Hill	38	09	38.57	97	56	47.08	G. S	Bull. 122.
Sheep Ranch		04	10.15		48	42.82	do	Do.
Walton		07	58.43		14	02.11	do	Do.
SE. corner sec. 36, T. 21, R. 1 E		10	27.58		15	44.98	do	Do.
SE. corner sec. 36, T. 22, R. 1 E		05	10.40		15	46.12	do	Do.
SE. corner sec. 8, T. 22, R. 2		08	40.37		33	17.20	do	Do.
SW. corner sec. 8, T. 22, R. 4		08	39.22		47	35.89	do	Do.
SW. corner sec. 4, T. 23, R. 3 W		04	18.44		39	50.32	do	Do.
SW. corner sec. 13, T. 21, R. 2 E		13	04.86		10	10.83	do	Do.
SW. corner sec. 33, T. 21, R. 1 E		10	24.77		20	09.69	do	Do.
Township corner		05	12.73		15	46.66	do	Do.
NE. corner sec. 13, T. 23, R. 5 W		03	24.96		48	38.43	do	Do.
NE. corner sec. 16, T. 22, R. 1 W		08	39.46		25	33.46	do	Do.
NE. corner sec. 16, T. 23, R. 1 E		02	57.72		20	38.70	do	Do.
	38°-39°			98°-99°				
Ackerman	38	07	21.59	98	50	45.32	do	Do.
Allon		49	41.74		52	20.46	C. & G. S	
Bunker Hill		52	20.26		42	18.52	do	
Cactus		24	17.00		52	06.63	G. S	Do.
Drifting Sand		09	44.89		26	51.08	do	Do.
Ellsworth		43	48.00		13	35.00	C. & G. S	
Golden Belt		58	48.25		18	25.72	do	
Heath		50	45.10		02	59.70	do	
Lyons		19	51.93		08	43.70	G. S	Do.
Millet		18	01.57		21	23.26	do	Do.
Mound		13	52.48		47	04.24	do	Do.
Pasture		22	23.95		39	33.57	do	Do.
Raymond		17	36.29		24	12.15	do	Do.
Sterling		13	14.64		12	24.26	do	Do.
Two		03	21.56		01	27.49	do	Do.
Wilson		51	55.97		29	18.17	C. & G. S	
SW. corner sec. 16, T. 21, R. 8		13	00.15		12	53.68	G. S	Do.
SW. corner sec. 23, T. 20, R. 10		17	23.38		24	20.49	do	Do.
SE. corner sec. 36, T. 20, R. 12		15	37.92		35	22.11	do	Do.
NE. corner sec. 16, T. 19, R. 14		24	17.21		51	56.28	do	Do.
NE. corner sec. 18, T. 21, R. 13		13	54.42		47	01.07	do	Do.
NE. corner sec. 12, T. 20, R. 8		19	57.41		08	43.50	do	Do.
NW. corner sec. 8, T. 22, R. 10		10	22.12		27	06.43	do	Do.
NW. corner sec. 28, T. 19, R. 12		22	33.39		39	46.92	do	Do.
NW. corner sec. 18, T. 23. R. 7		03	24.26		01	49.70	do	Do.
	38°-39°			99°-100°				
Blue Hill	38	59	01.93	99	05	58.46	C. & G. S	
Burdette		08	43.23		32	46.31	G. S	Do.
Cheese Factory		01	43.15		38	42.51	do	Do.
Dugout		15	21.16		13	44.80	do	Do.
Fair Mount		40	35.70		00	17.42	do	Do.
Frank		12	19.09		43	16.18	do	Do.
Garfield		06	29.63		13	56.68	do	Do.
Hays		54	56.66		16	16.86	C. & G. S	
Larned		07	55.74		03	52.94	G. S	Do.
La Crosse		35	42.96		16	10.33	C. & G. S	
Last Chance		03	40.85		36	12.94	G. S	Do.
Orwell		01	25.08		48	16.96	do	Do.
Pawnee		18	05.09		01	25.25	do	Do.
Quarry		15	19.81		25	18.54	do	Do.
SE. corner sec. 22, T. 21, R. 22		12	13.49		42	58.18	do	Do.
SE. corner sec. 15, T. 22, R. 16		07	49.36		03	27.13	do	Do.
SE. corner sec. 29, T. 23, R. 21		01	42.99		38	30.01	do	Do.
SE. corner sec. 25, T. 23, R. 23		01	16.87		47	17.96	do	Do.
SW. corner sec. 14, T. 23, R. 21		03	27.33		36	17.90	do	Do.
NW. corner sec. 19, T. 20, R. 15		18	15.26		01	53.60	do	Do.
NW. corner sec. 17, T. 22, R. 20		08	43.37		33	02.88	do	Do.
NW. corner sec. 5, T. 21, R. 19		15	42.32		25	26.48	do	Do.
NW. corner sec. 30, T. 22, R. 17		06	55.99		14	22.27	do	Do.
NW. corner sec. 6, T. 21, R. 17		15	38.22		14	01.82	do	Do.
	38°-39°			101°-102°				
Coyote	38	01	36.35	101	02	05.96	do	Do.
Lakin		00	38.35		14	06.41	do	Do.
NE. corner sec. 35, T. 22, R. 36		00	58.76		13	46.56	do	Do.
NW. corner sec. 27, T. 23, R. 34		01	53.62		02	47.72	do	Do.
Fort Scott:	37°-38°			94°-95°				
Standpipe	37	49	54.08	94	42	58.13	do	Bull. 49.
Spire on cupola of Central School		50	17.28		42	28.19	do	Do.
Spire of Congregational church		50	15.20		42	26.91	do	Do.
Flagstaff in national cemetery		49	21.14		41	33.04	do	Do.
Astronomical pier		50	25.76		42	26.75	do	Do.
SE. corner sec. 31, T. 25 S., R. 25 E., Bourbon County.		49	13.79		41	42.71	do	Do.

KANSAS—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	37°-38°	94°-95°		
	° ′ ″	° ′ ″		
ner S. side sec. 31, T. 25 S., R. ourbon County.	37 49 13.73	94 42 15.84	G. S	Bull. 49.
er T. 25 S., R. 25 E., Bourbon .	49 13.75	42 48.78	do	Do.
	37°-38°	95°-96°		
Baptist church	37 10 09.45	95 06 22.16	do	Do.
of court-house	09 58.93	06 24.08	do	Do.
Methodist church	10 13.24	06 32.11	do	Do.
schoolhouse	10 09.00	06 48.64	do	Do.
tte County astronomical pier	09 59.81	06 24.66	do	Do.
ne house	09 58.80	06 28.66	do	Do.
ner T. 30 S., R. 21 E., Labette .	12 33.38	09 26.37	do	Do.
er T. 33 S., R. 21 E., Labette .	11 41.00	09 26.31	do	Do.
:	37°-38°	96°-97°		
Methodist church	37 22 19.87	96 11 22.79	do	Do.
nomical pier	22 03.64	11 14.46	do	Do.
ner S. sec. 10, T. 31 S., R. 11 E., unty.	21 33.82	11 23.45	do	Do.
r T. 30 S., R. 11 E., Elk County	23 18.08	08 32.13	do	Do.
r sec. 10, T. 31 S., R. 11 E., Elk .	21 33.89	10 49.67	do	Do.
er sec. 10, T. 31 S., R. 11 E., Elk .	21 33.83	11 55.21	do	Do.
	37°-38°	99°-100°		
w	37 59 06.27	99 50 00.11	do	Bull. 122.
	51 12.71	59 54.26	do	Do.
le	56 30.51	57 14.45	do	Do.
le (astronomic pier)	59 06.34	45 10.05	do	Bull. 70.
	47 44.38	51 43.91	do	Bull. 122.
er sec. 8, T. 26, R. 23	47 34.78	52 06.17	do	Do.
r sec. 21, T. 24, R. 24	56 29.98	57 14.34	do	Do.
r sec. 3, T. 24, R. 23	59 06.21	49 30.70	do	Do.
er sec. 29, T. 25, R. 22	51 15.57	45 06.54	do	Do.
er sec. 30, T. 25, R. 24	51 14.31	52 57.20	do	Do.
	37°-38°	100°-101°		
	37 52 33.13	100 52 48.00	do	Do.
	49 25.42	19 39.01	do	Do.
lpipe	49 00.32	20 48.05	do	Do.
lhouse	48 31.02	20 40.80	do	Do.
n	46 17.35	41 27.65	do	Do.
	46 35.40	02 33.52	do	Do.
ity:				
h schoolhouse	58 19.70	52 23.70	do	Do.
schoolhouse	57 39.18	52 14.77	do	Do.
lpipe	57 50.35	52 41.89	do	Do.
ew	40 48.17	14 38.68	do	Do.
lhouse	51 21.97	20 07.73	do	Do.
	43 53.57	28 27.30	do	Do.
	51 01.57	28 03.64	do	Do.
d	58 23.46	45 28.05	do	Do.
	51 23.70	16 52.41	do	Do.
rairie schoolhouse	50 26.24	15 47.05	do	Do.
lle	53 23.74	38 07.09	do	Do.
olhouse	53 01.31	40 19.97	do	Do.
use, 4 miles east of Mans-	56 11.52	41 58.42	do	Do.
	51 51.54	06 58.89	do	Do.
er sec. 23, T. 27, R. 27	40 42.46	14 26.80	do	Do.
er sec. 36, T. 26, R. 31	44 03.73	39 10.82	do	Do.
er sec. 27, T. 25, R. 27	50 27.35	15 45.94	do	Do.
ner sec. 19, T. 25, R. 27	51 20.61	20 09.49	do	Do.
ner sec. 31, T. 25, R. 27	49 36.18	20 09.60	do	Do.
ner sec. 22, T. 25. R, 27	51 20.10	16 52.56	do	Do.
ner sec. 8, T. 25, R. 30	54 01.44	38 42.51	do	Do.
ner sec. 6, T. 27, R. 30	44 03.73	39 10.82	do	Do.
er sec. 30, T. 25, R. 32	51 29.25	52 23.63	do	Do.
er sec. 3, T. 27, R. 29	44 11.57	28 40.47	do	Do.
ner sec. 22, T. 26, R. 25	46 46.72	01 54.87	do	Do.
ner sec. 19, T. 25, R. 25	52 09.59	06 59.15	do	Do.
ner sec. 18, T. 24, R. 31	58 25.98	45 17.15	do	Do.
er sec. 26, T. 25, R. 29	50 56.11	27 49.80	do	Do.
	37°-38°	101°-102°		
	37 54 58.57	101 02 26.76	do	Do.
	47 48.35	23 38.21	do	Do.
l schoolhouse	58 54.76	08 06.13	do	Do.
l	55 17.46	22 32.83	do	Do.
olhouse	53 21.06	22 03.49	do	Do.
k	53 05.37	13 56.65	do	Do.

KANSAS—Continued.

Name.	Latitude.			Longitude.			Authority.	Referenc
	37°-38°			101°-102°				
	°	′	″	°	′	″		
Lakin schoolhouse	37	56	30.75	101	15	27.00	G. S	Bull. 122.
NW. corner sec. 11, T. 25, R. 36		54	00.98		14	53.67	do	Do.
NE. corner sec. 15, T. 24, R. 34		58	25.84		01	43.08	do	Do.
NW. corner sec. 15, T. 24, R. 34		58	25.27		02	49.03	do	Do.
W. ¼ corner sec. 34, T. 24, R. 37		55	17.81		22	32.94	do	Do.

MONTANA.

Name.	Latitude.			Longitude.			Authority.	Referenc
	48°-49°			104°-105°				
	°	′	″	°	′	″		
Big Horn	48	06	26.66	104	23	40.17	Mo. R. C	Rept. '91.
Big Muddy		09	47.47		34	02.50	do	Do.
Boulder		04	35.98		31	44.79	do	Rept. '94.
Box Elder		10	33.79		48	22.05	do	Rept. '91.
Devil's Elbow		06	08.14		44	40.85	do	Do.
Lanark		06	16.91		13	52.58	do	Do.
Montana		01	47.75		03	08.55	do	Do.
Mortar Stone		04	04.97		57	13.97	do	Do.
St. Ange		02	06.68		18	58.33	do	Do.
	48°-49°			105°-106°				
Deer Tail	48	07	35.92	105	04	11.31	do	Do.
Elk River		00	25.69		46	55.42	do	Do.
Hopkins		02	08.68		38	43.35	do	Do.
Macon		08	19.77		29	42.52	do	Do.
Oswego		04	22.75		51	26.01	do	Do.
Poplar		08	59.28		14	09.51	do	Do.
Red Water		02	37.76		09	02.55	do	Do.
Santee		03	27.58		55	59.62	do	Do.
Spread Eagle		03	36.87		27	32.59	do	Do.
Wolf Point		06	26.05		41	55.68	do	Do.
	48°-49°			106°-107°				
Galpin	48	05	17.67	106	26	06.81	do	Do.
Knityre		03	33.93		09	22.09	do	Do.
Lennox		04	11.32		00	58.51	do	Do.
Milk River		01	48.31		18	48.58	do	Do.
Nassau		05	36.59		18	22.52	do	Do.
Peck		00	11.09		32	38.43	do	Do.
	48°-49°			109°-110°				
Bear Paw	48	09	00.00	109	38	58.00	G. S	Bull. 122.
	48°-49°			110°-111°				
Coal banks	48	02	03.88	110	15	33.74	Mo. R. C	Rept. '91.
Old		03	26.97		09	39.62	do	Do.
Recess		00	49.09		20	01.91	do	Do.
Sandy		00	38.09		04	48.12	do	Do.
Shanks		00	08.83		14	22.37	do	Do.
	48°-49°			111°-112°				
Sweet Grass	48	50	52.60	111	22	21.00	G. S	Bull. 122.
	47°-48°			104°-105°				
Cut-off	47	59	47.20	104	09	54.16	Mo. R. C	Rept. '91.
Ferry		58	33.35		04	24.47	do	Do.
	47°-48°			105°-106°				
Amelia Poe	47	59	00.40	105	58	22.00	do	Do.
	47°-48°			106°-107°				
Bone Bluffs	47	59	41.26	106	09	55.95	do	Do.
Double Hill		49	41.74		41	27.69	do	Do.
Dry Fork		56	41.03		22	37.37	do	Do.
Featherland		42	33.32		50	33.24	do	Rept. '94.
Five Pines		46	52.24		52	18.35	do	Rept. '91.
Hell Creek		39	47.17		53	31.71	do	Do.
Juniper		53	44.55		34	18.87	do	Do.
Last Pine		50	53.27		29	17.43	do	Do.
Norris		44	37.67		40	43.43	do	Rept. '94.
	47°-48°			107°-108°				
Above	47	32	03.84	107	54	20.64	do	Rept. '91.
Ball Rock		39	29.88		30	57.03	do	Do.
Below		30	31.59		50	14.12	do	Do.
Cowboy		28	31.05		55	47.75	do	Do.
Cut-off		34	08.71		54	33.34	do	Do.
Dogtown		36	20.51		32	31.11	do	Do.
East base		38	18.80		39	18.11	do	Do.
Elk		36	16.75		44	01.10	do	Do.
Forgey		39	16.00		39	41.14	do	Do.
Gibson		38	11.41		12	31.92	do	Do.
Grizzly		41	58.38		00	13.20	do	Do.

MONTANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference
	47°-48°			107°-108°				
	°	′	″	°	′	″		
Horn	47	35	59.26	107	40	47.11	Mo. R. C	Rept. '91.
Hornet		32	38.22		50	38.27	do	Do.
Lake		35	03.16		56	40.76	do	Do.
Little Snow		38	34.53		03	20.67	do	Do.
Mussel Shell		29	50.20		55	29.51	do	Rept. '86.
Do		29	20.98		52	02.33	do	Do.
Do		26	20.74		54	16.60	do	Rept. '94.
Mussel Shell Cowboy		28	16.80		55	46.48	do	Rept. '86.
Nest		30	44.69		48	31.92	do	Rept. '91.
Pike		33	23.66		57	46.33	do	Do.
Raid		30	04.46		55	30.78	do	Do.
Rock Peak		43	18.56		24	39.82	do	Do.
Seven Black Feet		38	36.12		23	05.48	do	Do.
Three Canyon		42	24.37		11	22.41	do	Do.
Track		33	08.75		43	45.43	do	Do.
Tail		36	59.04		37	19.34	do	Rept. '94.
West base		37	48.39		41	32.56	do	Rept. '91.
Wilson		34	03.26		47	01.22	do	Do.
Williams		29	35.23		52	03.60	do	Do.
	47°-48°			108°-109°				
Across	47	35	01.82	108	05	55.67	do	Do.
Armel		36	25.62		38	57.90	do	Do.
Autumn		36	28.04		24	43.91	do	Do.
Bend		43	12.03		54	59.54	do	Do.
Brevier		36	01.95		36	05.20	do	Do.
Buffalo		38	56.75		40	38.60	do	Do.
Calf Island		37	59.82		44	03.36	do	Do.
Carroll, astronomic monument		34	48.00		24	00.00	Engr. Corps	Rept. '76.
Carroll		33	33.51		21	15.46	Mo. R. C	Rept. '91.
Cow Island		45	37.23		57	32.53	do	Do.
Creek		37	30.45		29	27.15	do	Do.
Crystal		42	00.81		52	22.07	do	Do.
Fortress		44	34.39		51	10.03	do	Do.
Frost		35	42.61		01	32.91	do	Do.
Grand Island		42	09.59		46	57.53	do	Do.
Harriet		38	08.92		36	04.82	do	Do.
Hawley		37	19.61		05	52.90	do	Do.
Kammuck		35	35.00		10	04.69	do	Do.
Landing		46	18.05		54	36.27	do	Do.
Line		33	51.19		07	46.80	do	Do.
Lopp		34	40.37		25	48.83	do	Do.
Plain		35	47.63		16	04.09	do	Do.
Quarter		40	03.27		48	54.73	do	Do.
Rocky Point		35	05.31		28	12.45	do	Do.
Ryan		35	30.56		20	19.07	do	Do.
Ryan Island		34	09.05		16	23.59	do	Do.
Sage		33	51.08		12	31.44	do	Do.
Slide		33	52.69		00	48.98	do	Do.
Snake Point		49	15.20		58	36.32	do	Do.
Willow		40	24.04		44	17.96	do	Do.
	47°-48°			109°-110°				
Arrow	47	41	16.56	109	48	25.54	do	Do.
Bear		44	33.20		26	43.77	do	Do.
Bird		45	47.33		08	35.83	do	Do.
Chimney		46	33.61		15	42.08	do	Do.
Camp Lewis		03	47.00		26	30.00	Engr. Corps	Rept. '76.
Council		46	25.29		35	22.22	Mo. R. C	Rept. '91.
Dauphin		43	44.99		21	54.71	do	Do.
Gallatin		42	35.84		27	45.47	do	Do.
Holmes		43	35.91		31	39.21	do	Do.
Iron City		45	22.32		31	02.96	do	Do.
Judith		13	07.90		13	15.60	G. S	Bull. 122.
Do		42	32.35		37	48.91	Mo. R. C	Rept. '91.
Lone Pine		47	45.88		19	42.25	do	Do.
Pablos		45	41.21		51	01.26	do	Do.
Pinnacles		48	14.73		57	00.84	do	Do.
Pines		41	14.31		42	49.03	do	Do.
Plateau		43	06.51		44	54.96	do	Do.
Rapids		46	06.09		22	48.14	do	Do.
Rondeau		44	04.21		54	17.48	do	Do.
Spruce		46	19.96		02	38.70	do	Do.
Sturgeon		48	43.10		04	14.66	do	Do.
Tip Top		44	02.31		49	46.99	do	Do.
Valley		44	48.93		42	20.15	do	Do.
Wall		46	32.02		59	10.46	do	Do.
Windsor		48	32.66		11	49.10	do	Do.
	47°-48°			110°-111°				
Arrow	47	25	40.70	110	31	35.90	G. S	Bull. 122.
Benton		48	46.57		41	58.56	Mo. R. C	Rept. '91.

MONTANA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	47°-48°			110°-°111				
Benton—Continued.	°	′	″	°	′	″		
Flagstaff, Fort Benton	47	48	50.00	110	39	48.00	Mo. R. C.	Rept. '86.
Hub		50	07.77		39	54.78	do	Do.
Black Bluff		54	14.75		26	45.31	do	Do.
Brule		51	12.81		30	24.63	do	Rept. '91.
Burned		57	21.22		03	37.90	do	Do.
Castle		53	35.28		02	53.16	do	Do.
Cherry		43	13.38		47	17.84	do	Do.
Citadel		50	32.65		02	30.41	do	Do.
Crocon		52	33.58		34	41.82	do	Do.
East base		50	40.25		40	04.27	do	Do.
Fort Benton		49	38.00		39	48.00	Engr. Corps	Rept. '76.
Flagstaff		49	03.97		39	49.88	Mo. R. C	Rept. '91.
Harvey		50	36.73		33	53.53	do	Do.
Highwood		39	23.28		52	42.02	do	Do.
Hub		50	22.02		39	56.05	do	Do.
Iron		59	10.69		08	35.41	do	Do.
Kipp		52	03.18		05	35.18	do	Do.
Labarge		49	22.72		04	55.60	do	Do.
Marias		56	22.17		29	10.45	do	Do.
Mound		58	47.44		17	50.70	do	Do.
Ridge		59	24.12		26	04.38	do	Do.
Shanks		59	54.58		14	21.10	do	Rept. '86.
Shonkin		49	46.05		36	51.86	do	Rept. '91.
Sheperd		34	56.62		56	19.23	do	Do.
Sidney		45	54.63		58	38.04	do	Do.
Tele		54	23.77		32	07.22	do	Do.
Teton		52	13.47		43	04.88	do	Do.
Three Islands		56	39.54		22	33.62	do	Do.
Tunis		48	21.61		49	09.03	do	Do.
Wellman		54	40.87		05	38.27	do	Do.
West base		50	11.78		42	22.60	do	Do.
White Cliffs		55	49.34		05	53.22	do	Do.
	47°-48°			111°-112°				
Antelope	47	26	31.90	111	25	39.49	do	Do.
Belt		31	56.14		01	44.37	do	Do.
Big Bend		21	56.84		16	47.17	do	Do.
Bromedy		32	02.94		08	14.02	do	Do.
Cascade		16	57.73		42	35.55	do	Do.
Craig		08	08.17		57	39.28	do	Do.
Divide		18	18.23		31	35.45	do	Do.
Earley		35	24.18		06	59.64	do	Do.
Epler		26	27.04		21	28.03	do	Do.
Fort Shaw		30	33.00		48	19.50	Engr. Corps	Rept. '76.
Great Falls		29	44.61		15	01.52	Mo. R. C	Rept. '91.
Hardy		13	01.29		48	39.11	do	Do.
Henry		30	35.42		11	24.85	do	Do.
Muddy Creek		21	32.05		35	28.17	do	Do.
North Great Falls		31	49.87		15	26.23	do	Do.
Portage		39	16.64		05	17.12	do	Do.
Porter		33	51.22		10	36.12	do	Do.
Sand Conlee		25	53.99		16	35.23	do	Do.
Sheep Creek		10	09.45		42	23.21	do	Do.
St. Clair		14	45.84		37	02.99	do	Do.
Stickney		06	53.30		51	11.28	do	Do.
Shaw		26	29.70		44	56.70	G. S	Bull. 122.
Sugarloaf		09	53.40		54	14.73	Mo. R. C	Rept. '91.
Sun River		28	44.79		21	13.92	do	Do.
Transfer		31	23.80		19	48.32	do	Do.
Ulm		26	23.11		31	04.52	do	Do.
Wagner		04	54.28		55	41.24	do	Do.
Wilson		24	03.17		24	39.61	do	Do.
	47°-48°			112°-113°				
Keep Cool	47	07	08.20	112	44	21.20	G. S	Bull. 122.
Rock Creek		03	28.37		00	32.99	Mo. R. C	Rept. '91.
Rocky		48	53.50		48	03.10	G. S	Bull. 122.
Wolf Creek		00	38.41		03	34.61	Mo. R. C	Rept. '91.
	47°-48°			113°-114°				
McDonald	47	23	11.00	113	55	18.00	G. S	Bull. 122.
	46°-47°			105°-106°				
Fort Keogh	46	23	11.65	105	56	53.08	Engr. Corps	Rept. '79.
	46°-47°			107°-108°				
East base (Custer Z. station)	46	07	55.70	107	31	00.30	G. S	Bull. 122.
Terry		10	36.20		36	12.00	do	Do.
West base		06	10.60		33	18.10	do	Do.
	46°-47°			109°-110°				
Big Snowy	46	45	12.30	109	18	48.80	do	Do.
	46°-47°			110°-111°				
Brewer Springs	46	32	50.00	110	55	40.00	Engr. Corps	Rept. '76.
Crazy		01	13.10		16	36.20	G. S	Bull. 122.

MONTANA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	46°-47°	110°-111°		
	° ′ ″	° ′ ″		
	46 27 17.60	110 45 12.30	G. S.	Bull. 122.
ate Springs	23 40.00	53 30.00	Engr. Corps	Rept. '76.
	58 15.10	36 22.50	G. S	Bull. 122.
	46°-47°	111°-112°		
n	46 50 00.68	111 53 07.21	Mo. R. C	Rept. '91.
	00 30.20	27 08.39	do	Do.
reek	29 06.93	34 59.09	do	Do.
ntain	53 53.48	59 03.10	do	Do.
ll	36 46.75	35 45.27	do	Do.
	17 46.30	54 14.00	do	Do.
	20 24.18	32 05.67	do	Do.
ker	40 44.00	11 00.00	Engr. Corps	Rept. '76.
erry	38 43.09	44 22.38	Mo. R. C	Rept. '91.
	05 41.54	21 58.72	do	Do.
ate	30 13.77	31 09.79	do	Do.
	34 43.24	40 19.41	do	Do.
ek	18 38.94	26 28.25	do	Do.
ty	09 55.63	28 40.36	do	Do.
ek	27 18.96	28 06.48	do	Do.
lo	44 31.80	48 44.29	do	Do.
	10 06.61	23 48.50	do	Do.
	41 10.76	45 20.00	do	Do.
	33 12.86	32 12.82	do	Do.
	46 10.07	55 48.43	do	Do.
	15 42.71	30 19.67	do	Do.
	12 42.93	30 34.69	do	Do.
	01 03.34	30 31.21	G. S	Bull. 122.
sh	08 52.28	22 26.53	Mo. R. C	Rept. '91.
	02 59.68	22 22.11	do	Do.
	24 21.71	26 35.96	do	Do.
	40 25.96	40 00.33	do	Do.
	59 45.10	55 42.40	do	Do.
	57 33.39	59 28.12	do	Do.
Moore Mountain)	55 54.80	44 01.10	do	Do.
Rock	07 49.71	24 57.99	do	Do.
	05 36.80	24 12.72	do	Do.
Pear	43 11.57	53 26.59	do	Do.
	25 58.97	33 54.40	do	Do.
	13 36.79	25 37.74	do	Do.
	02 51.66	25 44.60	do	Do.
	31 36.95	36 45.88	do	Do.
	39 38.06	51 04.31	do	Do.
reek	56 23.28	53 00.14	do	Do.
	46°-47°	112°-113°		
	46 58 56.00	112 16 54.00	G. S	Bull. 122.
	21 07.30	58 48.60	do	Do.
	45°-46°	107°-108°		
Abbott's Urn)	45 40 48.80	107 22 59.50	do	Do.
	34 30.40	16 50.10	do	Do.
t	36 43.50	47 04.30	do	Do.
rn	03 26.00	25 49.70	do	Do.
	49 37.50	50 50.30	do	Do.
ge	59 14.60	39 34.70	do	Do.
	11 08.30	26 42.70	do	Do.
f	02 16.90	11 33.30	do	Do.
	20 41.20	11 32.40	do	Do.
rass	21 06.60	33 51.70	do	Do.
	54 22.10	27 07.00	do	Do
	45°-46°	108°-109°		
a	45 42 39.70	108 08 56.70	do	Do.
	42 59.30	27 32.20	do	Do.
y	31 13.70	35 48.50	do	Do.
	50 03.20	47 40.90	do	Do.
e Terre	33 41.90	19 41.10	do	Do.
	45°-46°	109°-110°		
	45 09 56.00	109 48 22.00	do	Do.
	30 45.30	08 11.50	do	Do.
r	35 28.00	34 16.20	do	Do.
eaver	50 05.20	18 01.80	do	Do.
	51 48.10	39 10.10	do	Do.
	45°-46°	110°-111°		
, Station X	45 41 15.30	110 59 19.20	Wheeler	Do.
Mountain	47 36.80	56 15.60	G. S	Do.
Peak	00 27.04	50 15.05	do	Do.
t Peak	15 54.13	42 25.35	do	Do.
s, flagstaff	40 13.45	58 30.97	Wheeler	Do.
noll	41 42.64	59 00.18	G. S	Do.
k	11 55.89	13 17.58	do	Do.

MONTANA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46°	110°-111°		
	° ′ ″	° ′ ″		
Livingston	25 35 30.60	110 27 33.60	G. S.	Bull. 122.
Pass	30 39.80	01 08.40	do	Do.
	45°-46°	111°-112°		
Blackmore, mountain	45 26 48.02	111 00 13.40	do	Do.
Bozeman:				
Astronomical station	40 51.92	02 36.64	do	Do.
North base	42 45.29	06 26.08	do	Do.
South base	39 09.64	04 02.09	do	Do.
Station Y	40 00.52	01 37.08	Wheeler	Do.
Campbell	56 55.82	29 09.18	Mo. R. C	Rept. '91.
Cedar Knoll	39 03.61	13 36.46	G. S	Bull. 122.
Cedar Hill	56 43.20	27 44.22	Mo. R. C	Rept. '91.
Clarke	59 58.75	23 05.51	do	Do.
Gallatin	22 13.27	21 56.86	G. S	Bull. 122.
Do	56 07.65	28 43.28	Mo. R. C	Rept. '91.
Huntley	57 50.20	25 42.38	do	Do.
North base	55 43.36	30 04.84	do	Do.
Point 5	51 24.87	09 12.76	G. S	Bull. 122.
South base	54 58.35	29 43.63	Mo. R. C	Rept. '91.
Spring	57 57.52	28 10.92	do	Do.
	45°-46°	112°-113°		
Jefferson	45 36 49.38	112 00 29.62	G. S	Bull. 122.
Tweedy	28 57.00	57 56.60	do	Do.
	44°-45°	111°-112°		
Hilgard	44 55 08.17	111 27 32.99	do	Do.
Sawtelle	33 56.05	26 40.33	do	Do.

WYOMING.

	44°-45°	107°-108°		
	° ′ ″	° ′ ″		
Cloud Peak	44 23 00.20	107 10 23.00	G. S	Bull. 122.
	44°-45°	109°-110°		
Index Peak	44 58 36.60	109 53 04.00	Hayden	Rept. '77.
Do	58 41.88	52 53.07	G. S	Bull. 122.
	44°-45°	110°-111°		
Sheridan	44 16 06.02	110 31 44.81	do	Do.
Washburne	47 58.95	26 01.85	do	Do
	43°-44°	104°-105°		
Northwest corner of Nebraska	43 00 04.20	104 02 49.60	do	
	43°-44°	106°-107°		
Fort McKinney	43 47 05.60	106 15 12.75	Engr. Corps.	Rept. '78.
	43°-44°	108°-109°		
Alamocita Peak	43 11 56.00	108 28 17.00	Wheeler	Rept. '79.
	43°-44°	109°-110°		
Fremont Peak	43 07 28.50	109 37 17.30	Hayden	Rept. '77.
Washakie Needle	44 51.70	12 19.70	do	Do.
Yount Peak	59 02.76	51 58.28	G. S	Bull. 122.
	43°-44°	110°-111°		
Gros Ventre Peak	43 16 54.40	110 14 00.50	Hayden	Rept. '77.
Hayden Mountain	44 29.60	48 22.80	do	Do.
Hoback Peak	05 04.20	34 27.30	do	Do.
	42°-43°	104°-105°		
Fort Laramie flagstaff	42 12 01.31	104 33 27.27	Engr. Corps.	Rept. '78.
	42°-43°	105°-106°		
Fort Fetterman	42 50 26.26	105 29 12.60	L. S	Final Rept.
Laramie Peak	16 00.00	26 50.00	Hayden	Rept. '77.
	42°-43°	107°-108°		
Rattlesnake Peak	42 10 01.70	107 03 35.90	do	Do.
Seminole Peak	15 23.50	14 30.00	do	Do.
Whiskey Peak	18 36.70	34 34.50	do	Do.
	42°-43°	108°-109°		
Yellow Butte	42 16 05.30	108 43 18.00	do	Do.
	42°-43°	109°-110°		
Atlantic Peak	42 36 59.30	109 00 16.50	do	Do.
Mount Bonneville	51 35.10	20 48.20	do	Do.
New Fork Peak	59 58.30	35 36.90	do	Do.
West Atlantic Peak	37 17.20	01 07.30	do	Do.
Wind River Peak	42 29.70	09 54.50	do	Do.

WYOMING—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	110°-111°		
	° ′ ″	° ′ ″		
Wyoming Peak	42 36 14.90	110 37 39.70	Hayden	Rept. '77.
Cheyenne:	41°-42°	104°-105°		
Astronomical station	41 07 46.62	104 48 51.30	Wheeler	Rept. '73.
Railroad depot	07 57.77	49 11.65	do	Rept. '79.
Russell, Fort D. A., flagstaff	08 38.83	50 24.47	do	Do.
	41°-42°	105°-106°		
Ames	41 07 54.55	105 23 44.32	G. S	Bull. 122.
Antelope	22 10.06	34 23.14	do	Do.
Astronomical pier	18 51.80	35 33.60	do	Do.
County road	21 02.92	42 16.45	do	Do.
Dale	10 54.33	27 39.88	do	Do.
Fort Sanders flagstaff	17 26.89	34 59.56	Wheeler	Rept. '73.
Jelm	05 52.06	58 28.70	G. S	Bull. 122.
Laramie	18 51.80	35 33.60	Wheeler	Rept. '72.
Lindsey	06 17.33	38 14.08	G. S	Bull. 122.
Quartzite	25 34.91	27 27.53	do	Do.
Rock Creek station, river bank of Rock Creek.	50 25.72	52 24.60	Engr. Corps	Rept. '78.
Sherman	07 50.00	23 33.15	C. & G. S	Rept. '84.
Soda	20 10.28	35 02.97	G. S	Bull. 122.
University	18 47.09	34 53.75	do	Do.
	41°-42°	106°-107°		
Fort Fred Steele flagstaff	41 46 50.63	106 56 54.27	Wheeler	Final Rept.
Medicine Bow	21 39.40	18 54.20	G. S	Bull. 122.
Mount Steele	50 14.80	59 59.60	Hayden	Rept. '77.
	41°-42°	107°-108°		
Cherokee Peak	41 48 54.60	107 19 42.80	do	Do.
East end of Rawlins base line	25 23.40	18 15.00	do	Do.
Rawlins Peak	48 14.90	16 14.90	do	Do.
Separation Peak	38 14.40	23 53.50	do	Do.
West end of Rawlins base line	46 16.50	21 30.60	do	Do.
	41°-42°	108°-109°		
Black Butte	41 33 29.40	108 48 12.70	do	Do.
Essex Mountain	58 22.20	58 20.60	do	Do.
	41°-42°	109°-110°		
Green River, astronomical observatory.	41 31 38.12	109 28 06.57	Wheeler	Final Rept.
Pilot Butte	38 34.00	21 19.60	Hayden	Rept. '77.
	41°-42°	110°-111°		
Medicine Butte	41 21 06.50	110 54 42.50	do	Do.

COLORADO.

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41°	102°-103°		
	° ′ ″	° ′ ″		
Julesburg, astronomical station	40 59 07.63	102 21 32.30	Wheeler	Final Rept.
	40°-41°	105°-106°		
Long's Peak	40 15 20.80	105 36 38.20	Hayden	Rept. '76.
	40°-41°	106°-107°		
Park View Peak	40 19 52.20	106 07 53.20	do	Do.
	39°-40°	103°-104°		
Holt	39 02 15.73	103 57 48.43	C. & G. S	Do.
Hugo	04 27.83	30 20.07	do	Do.
Coulson's house, chimney	07 55.27	27 50.43	do	Do.
Schoolhouse chimney	08 03.59	27 50.35	do	Do.
Section-house chimney	07 52.85	27 27.93	do	Do.
Overland	02 15.04	09 46.75	do	Do.
Subsidiary station	05 46.45	32 01.30	do	Do.
	39°-40°	104°-105°		
Denver, Coast Survey astronomical station.	39 45 21.71	104 59 31.94	do	Rept. '82.
Denver:				
East end of base	45 52.20	47 39.20	Hayden	Rept. '76.
West end of base	46 22.70	54 25.30	do	Do.
Schoolhouse	45 00.70	59 23.40	do	Do.
Derrick station	43 54.80	57 08.90	do	Do.
Divide	04 10.08	30 15.64	C. & G. S	
Dry Creek station	56 57.00	55 51.80	Hayden	Do.
Holcolm Hills	00 02.96	18 30.86	C. & G. S	
Hughes, astronomical station	59 24.09	48 58.80	Wheeler	Final Rept.

COLORADO—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
		39°-40°			105°-106°			
	°	′	″	°	′	″		
Evans, Mount	39	35	21.30	105	38	21.90	Hayden	Rept. '76.
Georgetown		42	36.36		41	27.64	Wheeler	Final Rept.
Morrison, Mount		40	12.40		12	55.30	Hayden	Rept. '76.
Platte Peak		15	40.50		05	49.00	do	Do.
South Boulder Peak		57	15.60		17	42.10	do	Do.
Torrey Peak		38	37.40		48	01.10	do	Do.
		39°-40°			106°-107°			
Ashcroft	39	02	28.60	106	46	43.40	G. S	Bull. 122.
Bien's Station, 12		08	36.70		52	22.40	do	Do.
Bien's Station, 47		13	17.40		44	10.50	do	Do.
Castle Peak		00	29.80		51	44.00	do	Do.
Highland		07	40.20		52	39.90	do	Do.
Holy Cross Mountain		28	05.20		28	39.10	Hayden	Rept. '76.
La Plata Mountain		01	50.30		28	09.20	do	Do.
Lincoln, Mount		21	09.10		06	26.80	do	Do.
Powell, Mount		45	41.10		20	10.20	do	Do.
		39°-40°			107°-108°			
Chair Mount	39	03	24.00	107	17	00.60	G. S	Bull. 122.
Leon Peak		04	51.00		50	24.70	Hayden	Rept. '76.
North Mam		23	16.60		51	43.80	do	Do.
Snow Mass		07	02.70		04	03.20	G. S	Bull. 122.
Sopris Peak:								
North end		15	52.90		10	21.10	Hayden	Rept. '76.
Middle summit		15	36.20		09	57.40	G. S	Bull. 122.
Treasury		00	46.20		06	00.70	do	Do.
		38°-39°			102°-103°			
Eureka	38	58	34.79	102	51	17.19	C. & G. S	
First View		47	37.47		32	26.54	do	
Section-house chimney		48	57.02		31	58.53	do	
Kit Carson		42	02.30		51	06.24	do	
Landsman		56	47.11		34	46.24	do	
		38°-39°			103°-104°		do	
Adobe	38	40	35.56	103	32	47.47	do	
Arroya		48	04.70		10	26.74	do	
Section-house chimney		51	15.33		07	35.32	do	
Cramer Gulch		35	30.87		55	25.46	do	
Square Bluffs		51	03.08		49	14.73	do	
		38°-39°			104°-105°			
Bear Creek	38	48	51.97	104	52	52.02	do	
Besores ranch, chimney		59	10.76		28	21.04	do	
Big Springs		45	01.22		14	40.77	do	
Colorado City, schoolhouse, southeast chimney.		50	43.76		51	09.31	do	Rept. '82.
Colorado Springs		49	58.02		49	06.14	do	Do.
United States Coast Survey station.		50	00.30		49	07.60	do	Do.
Public school flagstaff		50	06.21		48	58.63	do	Do.
Corps of Engineers, astronomical station.		49	38.69		49	16.47	do	Do.
College cupola		50	47.92		49	01.66	do	Do.
Corral Bluffs		52	06.45		35	05.34	do	Do.
El Paso:								
West base (1879)		58	37.96		34	50.31	do	
East base (1879), astronomical station.		57	17.10		27	12.98	do	
Glen Eyre		53	54.14		53	58.95	do	
Munson and Hamblin's barn		57	28.92		27	09.04	do	
Pemington, house chimney		58	42.62		41	57.72	do	
South Pueblo		15	42.84		36	57.53	Wheeler	
		38°-39°			105°-106°			
Clayton Cone	38	12	58.20	105	55	29.30	Hayden	Rept. '76.
Hunt Peak		23	03.30		50	30.50	do	Do.
Labran, astronomical monument		23	08.97		06	17.78	Wheeler	Do.
Pikes Peak		50	21.11		02	08.30	C. & G. S	
Rito Alto Peak		13	14.20		45	10.10	Hayden	Do.
San Luis base:								
South end		15	14.00		57	07.00	do	Do.
North end		19	40.30		59	04.40	do	Do.
		38°-39°			106°-107°			
Agency Peak	38	16	30.70	106	51	47.60	do	Do.
Gunnison, northeast corner Virginia avenue and Wisconsin street.		32	42.13		55	39.49	do	Do.
Harvard Mount		55	32.20		19	01.30	do	Do.
Hunt Peak		25	23.40		13	10.40	Wheeler	Final Rept.
Observatory Cone		34	40.60		51	36.70	do	Do.
Ouray Mount		25	26.10		13	15.70	Hayden	Rept. '76.
Princeton Mount		45	01.30		14	19.20	do	Do.
Station 23		16	34.60		06	00.60	do	Do.

COLORADO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	38°-39°	106°-107°		
	° ′ ″	° ′ ″		
24	38 19 34.20	106 12 52.90	Hayden	Rept. '76.
33	01 27.80	55 11.40	do	Do.
	38°-39°	107°-108°		
eak	38 00 14.00	107 47 22.00	Wheeler	Final Rept.
Mountain	47 38.60	02 23.90	do	Do.
Peak	54 46.20	30 05.50	do	Do.
Mount	11 42.50	55 38.60	do	Do.
eak	01 50.10	54 23.40	do	Do.
Mount	00 19.00	47 18.70	Hayden	Rept. '76.
ahgre Peak	04 23.00	27 30.10	do	Do.
k Peak	43 09.20	11 44.20	do	Do.
orn	03 45.60	30 30.90	Wheeler	Final Rept.
	38°-39°	108°-109°		
Iesa	38 53 34.00	108 10 26.00	do	Do.
	37°-38°	104°-105°		
eak	37 05 59.60	104 27 31.90	Hayden	Rept. '76.
anish Peak	23 40.50	54 59.90	do	Do.
anish Peak	22 37.60	59 24.30	do	Do.
d, United States Coast Sur- ation.	10 13.80	30 07.50	do	Do.
	37°-38°	105°-106°		
Peak	37 34 43.50	105 28 55.40	do	Do.
Peak	07 25.10	10 56.30	do	Do.
e Peak	58 05.30	34 54.00	do	Do.
l, Fort, flagstaff	25 27.33	25 33.73	Wheeler	Rept. '79.
	37°-38°	106°-107°		
Peak	37 06 21.60	106 37 24.50	Hayden	Rept. '76.
Peak	17 24.50	34 02.40	do	Do.
te Peak	28 58.00	25 53.00	Wheeler	Final Rept.
te Hill	40 13.80	21 25.50	do	Do.
b Peak	34 25.40	58 43.00	do	Do.
eak	21 01.50	41 38.80	do	Do.
is Peak	59 16.80	55 39.20	Hayden	Rept. '76.
28	35 18.10	32 16.40	do	Do.
81	02 30.60	37 31.60	do	Do.
iver Peak	34 31.70	58 40.20	do	Do.
t Peak	21 07.30	41 35.40	do	Do.
	37°-38°	107°-108°		
Mount	37 37 39.40	107 36 15.40	Wheeler	Final Rept.
Head	47 34.50	03 17.90	do	Do.
Peak	36 24.40	29 26.80	do	Do.
Mount	46 54.60	30 50.00	do	Do.
er Mountain	41 57.10	48 14.10	do	Do.
Mount	50 20.70	59 20.00	do	Do.
Peak	26 43.10	03 47.20	Hayden	Rept. '76.
eek Mountain	47 30.50	25 25.70	Wheeler	Final Rept.
ud Peak	56 26.70	25 07.80	do	Do.
nde Pyramid	40 52.20	23 19.20	Hayden	Rept. '76.
n Mount	40 53.70	23 11.30	Wheeler	Final Rept.
Mountain	47 09.60	42 03.60	do	Do.
Mount	50 26.40	59 16.90	Hayden	Rept. '76.
	37°-38°	108°-109°		
eak	37 50 24.20	108 05 37.20	Wheeler	Final Rept.
s Peak	26 44.20	05 02.20	Hayden	Rept. '76.
ne	53 19.20	15 04.40	do	Do.
k	17 03.00	46 42.50	G. S	Bull. 122.

NEW MEXICO.

	36°-37°	103°-104°		
	° ′ ″	° ′ ″		
	36 09 12.70	103 58 35.90	G. S	Bull. 122.
	36°-37°	104°-105°		
n, astronomical monument	36 30 10.01	104 54 59.04	Engr. Corps	Rept. '76.
n	37 33.20	11 08.00	G. S	Bull. 122.
	36°-37°	105°-106°		
Peak	36 50 06.00	105 13 09.40	Hayden	Rept. '76.
	05 42.90	03 38.30	G. S	Bull. 122.
ak	33 23.00	24 46.00	Wheeler	Final Rept.
	36°-37°	106°-107°		
	36 01 59.90	106 51 16.80	G. S	Bull. 122.
	00 28.00	23 03.30	do	Do.
Nutria	42 04.63	23 40.99	Engr. Corps	Rept. '76.
lara Mountain	00 25.80	22 54.00	Wheeler	Final Rept.

NEW MEXICO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	36°-37°	**107°-108°**		
	° ′ ″	° ′ ″		
La Huerfano	36 25 34.10	107 50 41.20	G. S	Bull. 122
	36°-37°	**108°-109°**		
San Juan Needle	36 41 15.20	108 49 50.40	Hayden	Rept. '76.
	35°-36°	**104°-105°**		
Aguilar	35 22 43.10	104 59 37.60	G. S	Bull. 122.
Canadian	59 03.60	35 15.10	do	Do.
Corazon	27 09.80	33 57.40	do	Do.
Montoya	43 21.00	09 43.30	do	Do.
	35°-36°	**105°-106°**		
Baldy	35 49 57.50	105 45 27.90	do	Do.
Bernal Hill	22 33.00	19 38.40	Wheeler	Final Rept.
Escobas Peak	32 02.00	42 45.00	do	Do.
Fort Union	54 24.86	00 51.15	Engr. Corps	Rept. '73.
Jacinto	05 26.00	26 59.40	G. S	Bull. 122.
Las Truchas Mountain	57 40.70	38 39.10	Wheeler	Final Rept.
Las Vegas	35 27.66	13 27.57	do	Do.
Rincon	46 03.10	33 11.40	G. S	Bull. 122.
Santa Fe	41 19.29	56 45.22	Wheeler	Final Rept.
Thompson	40 22,10	48 22.90	G. S	Bull. 122.
Albuquerque:	**35°-36°**	**106°-107°**		
Armijo House, flagstaff	35 05 02.25	106 39 11.64	do	Bull. 49.
Grant Block, flagstaff	05 03.12	39 11.09	do	Do.
San Felipe Hotel, flagstaff, Gold avenue.	04 59.78	39 21.02	do	Do.
Astronomic pier	04 32.40	39 12.47	do	Do.
Catholic church cross	05 09.70	39 23.04	do	Do.
Jemes	41 44.70	51 30.60	do	Do.
Placer Mountain	20 03.40	10 36.00	Wheeler	Final Rept.
Sandia	14 07.30	27 22.00	G. S	Bull. 122.
Tetilla Peak	36 24.30	13 00.80	Wheeler	Final Rept.
SW. corner sec. 17, T. 10 N., R. 3 E	05 13.26	39 35.66	G. S	Bull. 122.
	35°-36°	**107°-108°**		
Taylor	35 14 20.70	107 36 29.20	do	Do.
	35°-36°	**108°-109°**		
Astronomical pier	35 30 51.38	108 32 27.32	do	Do.
Chusca	53 06.70	50 14.50	do	Do.
East base	30 17.80	30 28.08	do	Do.
Fort Wingate, flagstaff	28 49.47	32 20.00	Wheeler	Final Rept.
Hosta	35 13.50	11 29.90	G. S	Bull. 122.
McKenzie	21 18.70	26 35.10	do	Do.
Nell	25 13.50	37 24.90	do	Do.
Pyramid	33 18.80	37 01.10	do	Do.
Square Mesa	13 07.70	16 46.90	do	Do.
Twins	29 39.80	50 04.50	do	Do.
West base	31 48.38	34 30.74	do	Do.
Zuni	07 25.90	54 40.30	do	Do.
	34°-35°	**104°-105°**		
Jospinto No. 1	34 56 42.00	104 57 10.00	do	Do.
Jospinto No. 2	56 36.80	56 57.20	do	Do.
	34°-35°	**105°-106°**		
Pedernal	34 50 44.00	105 38 38.30	do	Do.
Pedernal Peak	50 38.50	39 04.20	Wheeler	Final Rept.
Rattlesnake Hill	34 07.50	49 41.40	do	Do.
Tecolote Peak	04 37.00	41 44.00	do	Do.
	34°-35°	**106°-107°**		
Manzano Peak	34 35 23.20	106 27 12.20	do	Do.
Mosca Peak	48 36.50	24 34.50	do	Do.
Osha Peak	38 09.30	26 43.60	do	Do.
	34°-35°	**107°-108°**		
Ladrones	34 26 01.00	107 05 29.50	do	Do.
	34°-35°	**108°-109°**		
Pinon	34 11 51.10	108 27 52.10	G. S	Bull. 122.
	33°-34°	**105°-106°**		
Blanca Peak	33 22 24.00	105 48 55.00	Wheeler	Final Rept.
Capitan Peak	35 24.40	16 20.30	do	Do.
East Carrizo Cone	38 59.60	37 17.50	do	Do.
Fort Stanton, flagstaff	29 35.72	31 59.72	do	Do.
Nogal Peak	29 47.50	48 36.20	do	Do.
	33°-34°	**106°-107°**		
Colorado Mountain	33 50 42.00	106 42 06.00	do	Do.
Salinas Peak	17 50.60	32 15.00	do	Do.
	33°-34°	**107°-108°**		
Caballo Cone	33 06 01.80	107 13 40.40	do	Do.
Fort Craig, flagstaff	38 00.99	01 07.96	do	Do.

NEW MEXICO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	33°-34°	**107°-108°**		
	° ′ ″	° ′ ″		
Fra Cristobal Mount	33 25 35.00	107 07 10.10	Wheeler	Final Rept.
Mount Magdalena	59 23.20	11 39.10	do	Do.
San Mateo Mountain	33 07.30	26 04.90	do	Do.
	33°-34°	**108°-109°**		
Eagle Peak	33 40 33.20	108 34 41.30	do	Do.
Horse Peak	58 38.20	07 29.90	do	Do.
Round Peak	40 28.70	06 06.70	do	Do.
Tuleroso	40 37.70	34 34.90	G. S	Bull. 122.
	32°-33°	**105°-106°**		
Cornuda	32 01 28.44	105 30 57.65	do	Do.
	32°-33°	**106°-107°**		
Organ Mountain	32 20 34.40	106 33 40.50	Wheeler	Final Rept.
	32°-33°	**107°-108°**		
Florida Peak	32 07 18.30	107 37 19.20	do	Do.
Mount Cooke	32 01.40	43 53.90	do	Do.
Sunday Cone	37 08.50	26 54.00	do	Do.
	32°-33°	**108°-109°**		
Bear Peak	32 50 00.70	108 21 31.60	do	Do.
Black Peak	54 26.00	09 46.90	do	Do.
Fort Bayard, astronomical monument	47 40.35	09 08.77	do	Do.
	31°-32°	**106°-107°**		
Rodadero Peak	31 47 10.30	106 32 31.70	do	Do.
	31°-32°	**107°-108°**		
Potrillo Peak	31 55 21.00	107 04 07.00	do	Do.
	31°-32°	**108°-109°**		
Hacheta Peak	31 37 58.20	108 23 57.00	do	Do.
Lalacha Peak	50 21.20	27 13.60	do	Do.

ARIZONA.

	36°-37°	**109°-110°**		
	° ′ ″	° ′ ″		
Calabasa	36 22 18.30	109 50 16.70	G. S	Bull. 122.
Pastora	47 25.10	09 52.80	do	Do.
Roof Butte	27 37.10	05 31.40	do	Do.
Sonsala	06 05.20	04 41.70	do	Do.
	36°-37°	**110°-111°**		
Wilson	36 12 48.30	110 09 13.60	do	Do.
	36°-37°	**111°-112°**		
Paria Needle	36 51 00.60	111 40 54.60	Powell	Do.
Paria Station	50 49.20	40 47.70	do	Do.
	36°-37°	**112°-113°**		
Brink	36 26 01.60	112 25 11.60	do	Do.
Brow	35 25.00	23 56.70	do	Do.
Duffer	56 50.10	00 50.20	do	Do.
Kanab:				
North	57 46.50	31 21.40	do	Do.
South	54 04.10	31 50.90	do	Do.
New	55 29.80	35 36.40	do	Do.
Pipe	52 37.30	48 37.40	do	Do.
Pipe Springs, camp near	51 36.34	42 57.00	Wheeler	Rept. '76.
Shinarump	57 53.90	26 45.00	Powell	Bull. 122.
Three Trees	59 27.60	41 51.30	do	Do.
	36°-37°	**113°-114°**		
Emma	36 15 50.20	113 10 12.40	G. S	Do.
	35°-36°	**109°-110°**		
Crofton	35 11 39.30	109 06 51.80	do	Do.
Douglas	09 08.60	52 35.10	do	Do.
Iola	26 18.40	38 10.60	do	Do.
Zilh Tusayan	53 11.70	14 55.10	do	Do.
	35°-36°	**110°-111°**		
Cottonwood	35 30 26.70	110 18 59.60	do	Do.
Oraibe	52 50.40	42 49.20	do	Do.
	35°-36°	**111°-112°**		
San Francisco	35 20 47.60	111 40 37.80	do	Do.
	35°-36°	**112°-113°**		
Bill Williams	35 11 59.60	112 12 15.40	do	Do.
Floyd	23 33.60	43 24.10	do	Do.
	35°-36°	**113°-114°**		
Hualapai	35 04 30.20	113 53 48.30	do	Do.

ARIZONA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	35°-36°	114°-115°		
	° ′ ″	° ′ ″		
Dead	35 16 30.30	114 43 20.30	G. S	Bull. 122.
Fort Mohave	02 09.00	35 54.00	Wheeler	Final Rept.
Tipton	32 21.10	11 30.10	G. S	Bull. 122.
	34°-35°	109°-110°		
Haseltine	34 59 24.30	109 26 43.10	do	Do.
	34°-35°	110°-111°		
Chevlon	34 41 33.80	110 50 52.10	do	Do.
Sunset	54 14.70	57 39.80	do	Do.
Woodruff	47 56.70	02 31.10	do	Do.
	34°-35°	111°-112°		
Baker Butte	34 27 08.60	111 22 39.60	do	Do.
Mazatzal	03 45.70	27 38.50	do	Do.
	34°-35°	112°-113°		
Granite	34 38 17.00	112 33 08.30	do	Do.
Fort Whipple	33 06.12	27 10.20	Wheeler	Final Rept.
	34°-35°	113°-114°		
Aquarius	34 56 56.20	113 17 51.00	G. S	Bull. 122.
	33°-34°	109°-110°		
Ord Peak	33 56 16.00	109 36 15.80	do	Do.
Thomas Peak	54 24.10	34 16.00	Wheeler	Final Rept.
	33°-34°	111°-112°		
Brown Peak	33 41 04.20	111 19 29.60	G. S	Bull. 122.
	32°-33°	109°-110°		
Graham	32 41 58.90	109 52 18.90	Wheeler	Final Rept.

UTAH.

	41°-42°	111°-112°		
	° ′ ″	° ′ ″		
Barton Mountain	41 04 51.80	111 51 19.90	Wheeler	Final Rept.
Kimballs Mountain	57 40.00	13 57.00	do	Do.
Lake View Peak	57 35.90	14 07.30	Hayden	Rept. '77.
Naomi Peak	54 38.90	40 46.30	Wheeler	Final Rept.
North Lyon Peak	54 39.00	40 46.50	Hayden	Rept. '77.
North Ogden Mountain	21 44.80	57 53.00	Wheeler	Final Rept.
Observatory Peak	11 56.80	53 09.60	do	Do.
Ogden, stone post in observatory	13 08.56	59 56.10	L. S	
Ogden Peak	11 56.70	53 09.50	Hayden	Rept. '77.
Porcupine Mountain	01 07.00	07 06.80	Wheeler	Final Rept.
Willard Peak	21 44.90	57 53.10	Hayden	Rept. '77.
	41°-42°	112°-113°		
Black Butte	41 55 36.00	112 07 37.00	Wheeler	Final Rept.
Blue Spring Peak	47 36.00	32 54.40	do	Do.
Box Elder Peak	38 05.90	01 07.30	do	Do.
Promontory Mountain	29 21.80	30 44.90	do	Do.
South Promontory Mountain	18 45.80	27 04.90	do	Do.
	41°-42°	113°-114°		
Clear Creek Mountain	41 41 22.50	113 44 44.00	do	Do.
Newfoundland Mountain	11 06.70	22 19.20	do	Do.
Tangent Peak	28 50.60	10 42.20	do	Do.
Camp Douglas:	40°-41°	111°-112°		
New flagstaff	40 45 47.50	111 50 14.22	do	Do.
Old flagstaff	45 47.58	50 14.07	do	Rept. '76.
Sundial	45 47.47	50 13.92	Engr. Corps	Do.
Provo (old Camp Rawlins)	13 47.84	40 27.00	Wheeler	Repts. '72-73.
Salt Lake City	46 04.00	53 47.10	C. & G. S	Rept. '84.
Spanish Fork	05 13.50	31 40.70	Powell	Bull. 122.
West Twin Peak	35 44.40	43 41.80	Wheeler	Final Rept.
	40°-41°	112°-113°		
Antelope Island	40 57 40.40	112 13 12.10	do	Do.
Provo	13 47.84	40 27.00	do	Rept. '76.
	40°-41°	113°-114°		
Deep Creek	40 06 01.71	113 57 16.05	do	Do.
Desert Mountain	57 02.40	47 36.20	do	Final Rept.
	39°-40°	109°-110°		
Culmination	39 11 27.10	109 46 47.50	Powell	Bull. 122.
	39°-40°	110°-111°		
Bruin	39 38 37.10	110 20 56.40	do	Do.
Indian Head	51 44.20	53 26.40	do	Do.
Red Plateau	10 14.00	37 10.90	do	Do.

UTAH—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	39°-40°	111°-112°		
	° ′ ″	° ′ ″		
Bare Brush	39 04 08.70	111 18 39.10	Powell	Bull. 122.
Ephraim	23 25.60	45 06.60	do	Do.
Fayette	12 31.50	49 20.30	do	Do.
Gunnison:				
Astronomical station	09 25.62	49 15.00	Wheeler	Final Rept.
North	08 28.30	49 16.20	Powell	Bull. 122.
South	03 10.20	49 16.20	do	Do.
Jura	04 49.70	46 00.60	do	Do.
Musinia	02 08.30	34 40.60	do	Do.
Nebo	48 35.40	45 59.70	do	Do.
South Tent	23 29.10	21 28.20	do	Do.
Valley	05 38.30	56 20.00	do	Do.
	39°-40°	112°-113°		
Canyon Range	39 23 30.70	112 12 26.50	do	Do.
	38°-39°	109°-110°		
Peale	38 26 18.10	109 13 44.30	G. S	Do.
Waas	32 21.20	13 39.70	do	Do.
Do	32 18.60	13 41.80	Powell	Do.
	38°-39°	110°-111°		
Ellen	38 07 14.30	110 48 53.60	do	Do.
	38°-39°	111°-112°		
Black Cap	38 57 16.30	111 49 15.70	do	Do.
Fort Cameron	16 53.34	44 00.31	Wheeler	Final Rept.
Hilgard	41 00.40	32 38.20	Powell	Bull. 122.
Marvine	40 02.90	38 28.30	do	Do.
Thousand Lake	24 58.50	28 45.30	do	Do.
	38°-39°	112°-113°		
Beaver, astronomical monument near center of public square.	38 16 23.28	112 38 35.90	Wheeler	Final Rept.
Belknap	25 06.60	24 45.50	Powell	Bull. 122.
Katherine	59 35.00	08 24.70	do	Do.
Richfield	46 11.40	02 27.00	Wheeler	Final Rept
	37°-38°	109°-110°		
Abajo	37 50 22.50	109 27 43.70	G. S	Bull. 122.
	37°-38°	110°-111°		
Navajo Mountain	37 02 02.90	110 52 08.70	do	Do.
Pennell	57 21.40	47 27.90	Powell	Do.
	37°-38°	111°-112°		
Table Cliff	37 41 08.70	111 54 08.60	do	Do.
	37°-38°	112°-113°		
Adams	37 55 53.80	112 12 20.90	do	Do.
Brian	40 49.30	49 53.10	do	Do.
John	02 52.50	30 56.70	do	Do.
Kanab, monument in square in front of Bishop's residence.	02 25.43	31 39.00	Wheeler	Rept. '76.
Little Creek	52 48.40	36 43.40	Powell	Bull. 122.
Mansard	02 52.30	25 22.00	do	Do.
Mollie	16 12.30	03 18.60	do	Do.
Navajo Well	03 36.70	16 45.00	do	Do.
Pink Cliff	25 02.70	19 21.10	do	Do.
Street	02 55.85	31 50.83	do	Do.
Tithing Yard	02 55.90	31 50.00	do	Do.
	37°-38°	113°-114°		
St. George	37 06 29.38	113 35 00.30	Wheeler	Final Rept.
Toquerville	15 19.88	16 20.90	do	Rept. '76.

NEVADA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	114°-115°		
	° ′ ″	° ′ ″		
Pilot Knob	41 01 12.20	114 04 51.50	Wheeler	Final Rept.
	41°-42°	119°-120°		
Division Peak	41 05 46.10	119 15 31.50	do	Do.
Mahogany Mount	01 26.40	33 17.90	do	Do.
Forty-nine Peak	33 24.00	55 23.00	do	Do.
Piute Peak	16 43.00	03 23.00	do	Do.
Yellow Mesa Peak	50 05.00	37 15.80	do	Do.
	40°-41°	115°-116°		
Fort Halleck	40 48 34.35	115 19 34.05	do	Do.
Camp Ruby	03 38.63	31 06.75	do	Do.
Elko	49 38.44	45 37.20	do	Do.

NEVADA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	40°-41°	116°-117°		
	° ′ ″	° ′ ″		
Battle Mountain, astronomical monument.	40 38 18.74	116 56 13.50	Wheeler	Final Rept.
	40°-41°	117°-118°		
Granite Peak, south end	40 22 30.10	117 31 35.80	C. & G. S.	
Winnemucca, astronomical monument.	58 19.97	43 54.16	Wheeler	Do.
	40°-41°	118°-119°		
Star Peak (Indian Peak)	40 31 15.47	118 10 16.61	C. & G. S.	
	40°-41°	119°-120°		
Granite Peak	40 47 22.60	119 25 47.70	Wheeler	Do.
Tohakum Peak	10 40.20	27 07.60	do	Do.
State Line Peak	01 44.00	58 32.40	do	Do.
Do	01 42.10	58 45.40	G. S	Bull. 122.
	39°-40°	115°-116°		
Hamilton	39 15 48.87	115 25 58.38	do	
Monte Cristo Mill	13 16.83	34 49.20	do	
	39°-40°	117°-118°		
Augusta Peak	39 32 18.58	117 55 11.91	C. & G. S.	
Austin, astronomical station	29 21.92	03 41.70	Wheeler	
Birchims Mount	08 53.60	28 33.50	do	Rept. '79.
Bunker Hill	15 05.02	07 35.83	C. & G. S.	
Cowles Peak	03 14.40	33 24.90	Wheeler	Do.
Desatoya:				
North Twin	22 04.20	45 36.80	C. & G. S.	
South Twin	21 49.41	45 34.53	do	
Emigrant Peak	24 10.20	23 20.10	Wheeler	Do.
Geneva Peak	21 27.00	04 14.90	do	Do.
Mount Grant	32 16.60	54 56.20	do	Do.
North Augusta	41 01.90	48 26.70	C. & G. S.	
Shoshone Peak:				
North	08 56.20	28 49.80	do	Do.
South	03 17.60	33 41.10	do	Do.
Toyabe Peak	21 28.71	04 32.74	do	Do.
	39°-40°	118°-119°		
Carson Sink	39 34 53.62	118 14 09.27	do	Do.
Carson Table	32 23.40	17 58.50	do	Do.
Fairview	13 24.86	09 10.77	do	Do.
Mount Lincoln	32 52.50	15 48.70	do	Do.
Tarogua Peak	34 51.70	13 54.20	Wheeler	Do.
	39°-40°	119°-120°		
Churchill Butte	39 20 16.30	119 17 32.20	do	Do.
Cleaver Peak	13 01.10	08 01.90	G. S	Bull. 122.
Como	01 11.40	28 27.59	C. & G. S	
Do	01 07.50	28 14.40	Wheeler	Final Rept.
Emma	17 39.30	36 00.90	do	Do.
Genoa	02 26.40	52 43.00	do	Do.
Genoa Peak	02 29.50	52 54.40	G. S	Bull. 122.
McClellan Mountain	15 26.10	41 46.20	Wheeler	Final Rept.
Mount Davidson	18 21.90	39 37.20	do	Do.
Do	18 24.09	39 49.78	C. & G. S	
Mount Lyon	07 33.20	23 12.40	Wheeler	Do.
Mount Rose	20 32.30	55 05.90	G. S	Bull. 122.
Mucca, Elephant Peak	58 28.40	44 40.10	C. & G. S	
Northeast base	25 43.00	25 39.00	Wheeler	Final Rept.
Pahrah	47 34.73	28 28.74	C. & G. S	
Peavine Mountain	35 07.40	55 57.00	G. S	Bull. 122.
Pond Summit	39 02.38	27 50.78	C. & G. S	
Rawe Mountain	11 56.51	28 40.40	Wheeler	Final Rept.
Rocky Point	20 50.20	34 02.40	do	Do.
Rose Mountain	20 30.30	54 54.10	do	Do.
Sage	07 35.66	28 24.97	C. & G. S	
Tibbie	22 08.60	31 54.60	Wheeler	Rept. '79.
Do	22 10.70	32 07.30	G. S	Bull. 122.
Twotips Mount	42 52.80	09 46.60	Wheeler	Final Rept.
Two Tips, north summit	42 54.70	09 59.90	C. & G. S	
Virginia City, astronomical monument.	17 35.92	39 06.35	do	
Virginia Peak	45 14.95	27 41.60	do	
Washoe Peak, monument	20 32.24	55 05.68	do	
	38°-39°	117°-118°		
Lone Mountain	38 01 22.26	117 29 41.77	do	Do.
Paradise Peak	48 15.90	49 22.70	Wheeler	Do.
Poston Mount	49 48.40	20 56.00	do	Do.
Toyabe Dome	49 52.29	21 12.85	C. & G. S	
	38°-39°	118°-119°		
Basalt Peak	38 59 09.80	118 25 59.00	Wheeler	Do.
Black Mount	56 19.40	54 39.60	G. S	Bull. 122.

NEVADA—Continued.

Name.	Latitude.			Longitude.			Authority.	Reference.
	38°-39°			118°-°119				
	°	'	"	°	'	"		
Cory Mount	38	33	57.40	118	47	15.90	Wheeler	Final Rept.
Mount Grant		34	07.83		47	30.60	C. & G. S	
Mount Hull (Cory's Peak)		26	47.70		46	58.10	do	
Pilot Cone		59	12.86		26	14.06	do	
Volcano		23	37.50		09	35.20	do	
Wassuck, south peak		46	57.92		50	05.57	do	
	38°-39°			119°-120°				
Desert Creek Peak	38	36	45.20	119	18	58.00	G. S	Bull. 122.
Mount Wilson		50	57.90		18	14.50	do	Do.
Saddle Galena		53	17.41		30	09.33	C. & G. S	
Silver Lake Mountain		51	45.00		28	34.00	Wheeler	Final Rept.
	37°-38°			114°-115°				
Pioche, observatory	37	55	26.07	114	26	18.27	do	Do.
	37°-38°			117°-118°				
Montezuma Peak	37	41	35.50	117	21	45.70	C. & G. S	
	36°-37°			115°-116°				
Charleston	36	16	18.00	115	41	38.70	G. S	Bull. 122.

IDAHO.

	44°-45°			115°-116°				
	°	'	"	°	'	"		
Packer John	44	10	52.00	115	47	24.25	G. S	Bull. 122.
	44°-45°			116°-117°				
Big Willow	44	12	20.60	116	27	02.71	do	Do.
Squaw		00	09.66		24	45.96	do	Do.
Middle Weiser		42	37.77		16	14.15	do	Do.
Weiser		15	56.20		54	05.40	do	Do.
	43°-44°			111°-112°				
Baird, Mount	43	21	46.70	111	05	54.80	Hayden	Rept. '77.
Caribou Mountain		05	36.20		18	56.70	do	Do.
	43°-44°			113°-114°				
Big Butte	43	23	42.20	113	01	38.00	Wheeler	Final Rept.
	43°-44°			114°-115°				
Green Spring	43	12	48.03	114	54	49.34	G. S	Bull. 122.
Kelly, Mount		29	30.71		28	04.61	do	Do.
Smoky Dome		29	33.93		56	14.94	do	Do.
Snowy Side		56	16.25		58	21.50	do	Do.
	43°-44°			115°-116°				
Camas	43	14	54.66	115	26	08.64	do	Do.
Cinder		13	07.26		59	40.65	do	Do.
House		25	57.75		29	21.53	do	Do.
North		35	54.90		25	48.56	do	Do.
Three Point		30	21.70		56	07.48	do	Do.
	43°-44°			116°-117°				
Boise, astronomical pier	43	35	57.98	116	13	04.04	do	Do.
Caldwell		42	16.52		41	46.82	do	Do.
East base		32	43.47		10	19.64	do	Do.
Flat Top		15	44.31		53	11.56	do	Do.
Initial Point		22	18.20		23	42.80	do	Do.
Lucky Peak		36	17.84		03	45.61	do	Do.
Pickels Butte		29	18.21		42	49.56	do	Do.
Shafer		46	16.45		05	25.26	do	Do.
South Ridge, 1		30	50.88		13	43.64	do	Do.
South Ridge, 2		28	28.67		06	47.39	do	Do.
Star		46	23.49		25	00.00	do	Do.
Table Rock		35	35.69		08	45.34	do	Do.
West base		35	14.19		14	49.70	do	Do.
Bear Valley base:	42°-43°			111°-112°				
East end	42	27	18.90	111	19	48.00	Hayden	Rept. '77.
West end		27	22.70		22	04.00	do	Do.
Castle Rock		12	09.00		33	08.00	Wheeler	Final Rept.
East Hill		28	49.70		19	19.60	Hayden	Rept. '77.
North Hill		31	15.60		24	54.50	do	Do.
Paris Peak		12	08.80		33	11.80	do	Do.
Preuss Mount		29	42.60		15	11.00	do	Do.
Sedgwick Peak		30	54.00		55	39.90	Wheeler	Final Rept.
Soda Peak		27	53.70		33	11.40	Hayden	Rept. '77.
South Hill		23	41.10		23	34.40	do	Do.

IDAHO—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	42°-43°	112°-113°		
	° ′ ″	° ′ ″		
Bannock Peak	42 36 08.80	112 42 43.00	Wheeler	Final Rept.
Deep Creek Mountain	28 13.10	39 37.70	do	Do.
Elkhorn Mountain, north point	20 00.30	19 56.60	do	Do.
Oxford Peak	16 07.60	06 05.40	do	Do.
Putnam, Mount	57 10.60	10 09.40	Hayden	Rept. '77.
South Putnam Peak	55 03.40	07 58.60	Wheeler	Final Rept.
	42°-43°	113°-114°		
Badger Peak	42 33 00.90	113 04 01.00	do	Do.
Black Pine Mountains	07 08.50	07 27.90	do	Do.
Cache Peak	11 04.10	39 54.80	do	Do.
Cedar Creek Mountain	26 46.10	03 34.60	do	Do.
Pillar Butte	52 57.70	13 08.70	do	Do.
	42°-43°	116°-117°		
Quicksilver	42 58 48.47	116 30 32.46	G. S	Bull. 122.

WASHINGTON.

Name.	Latitude.	Longitude.	Authority.	Reference.
	47°-48°	117°-118°		
	° ′ ″	° ′ ″		
Spokane Falls, monument one-fourth mile east of the town.	47 39 38.13	117 24 45.89	Engr. Corps	Rept. '82.
	47°-48°	122°-123°		
Seattle	47 35 57.20	122 19 58.70	C. & G. S	
Steilacoom:				
Presbyterian church	10 24.08	35 35.76	do	
Methodist church	10 23.03	35 50.88	do	
	46°-47°	117°-118°		
Colfax, monument on an island in Palouse River, at north end of the town.	46 53 13.69	117 23 29.13	Engr. Corps.	Do.
	46°-47°	118°-119°		
Wallawalla	46 03 55.89	118 20 50.14	Wheeler	Final Rept.
	46°-47°	122°-123°		
Kalama	46 00 17.80	122 50 33.20	C. & G. S	
	46°-47°	123°-124°		
Alamicut River	46 18 03.13	123 41 59.19	do	
Astoria Point	11 23.65	50 29.35	do	
Bakers Bay	16 27.50	55 49.17	do	
Base on east end	18 12.74			

OREGON.

Name.	Latitude.	Longitude.	Authority.	Reference.
	45°-46°	121°-122°		
	° ′ ″	° ′ ″		
Dalles	45 35 50.80	121 13 11.20	Wheeler	Final Rept.
	42°-43°	120°-121°		
Baldy	42 07 03.70	120 43 06.90	G. S	Bull. 122.
High Rock	29 42.70	52 40.40	do	Do.
Lolochewis Mountain	18 22.00	37 38.00	Wheeler	Final Rept.
North End Mountain	03 54.00	14 13.00	do	Do.
Sugarloaf Mountain	17 57.60	07 12.40	do	Do.
	42°-43°	122°-123°		
Pitt	42 26 36.40	122 18 58.40	G. S	Bull. 122.
Scott	55 18.90	01 00.20	do	Do.
	42°-43°	123°-124°		
Kirby	42 13 08.20	123 27 42.60	do	Do.

CALIFORNIA.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	120°-121°		
	° ′ ″	° ′ ″		
Alturas Hill	41 28 57.70	120 32 43.00	Wheeler	Final Rept.
Bidwell Mount	56 52.60	07 49.80	do	Do.
Bidwell Fort, flagstaff	51 30.84	09 15.56	do	Do.
Cedar Mount	36 31.90	16 00.20	do	Do.
Eagle Mountain	16 56.00	11 51.40	do	Do.
Hat Mountain	03 57.00	05 47.90	do	Do.

CALIFORNIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	41°-42°	122°-123°		
	° ′ ″	° ′ ″		
	41 24 27.60	122 11 42.90	G. S	Bull. 122.
	40°-41°	120°-121°		
er Peak	40 41 11.00	120 35 44.40	Wheeler	Final Rept.
ings Peak	22 24.80	07 07.30	do	Do.
ock Peak	08 42.00	43 03.10	do	Do.
k Peak	05 22.90	14 43.10	do	Do.
ld Peak	56 23.20	24 35.70	do	Do.
tion Peak	46 22.20	10 06.90	do	Do.
Mount	26 43.10	21 18.60	do	Do.
ork Mountain	09 14.30	33 39.50	do	Do.
on Peak	15 34.10	33 17.40	do	Do.
Peak	22 38.70	12 59.60	do	Do.
	40°-41°	121°-122°		
ountain	40 12 58.20	121 23 02.10	do	Do.
ount	14 15.20	01 48.40	do	Do.
n Butte	36 35.70	33 13.50	G. S	Bull. 122.
Butte	29 11.21	30 16.21	C. & G. S	Do.
	40°-41°	122°-123°		
	40 02 05.70	122 51 16.50	G. S	Do.
	40°-41°	123°-124°		
on	40 58 15.20	123 00 09.90	do	Do.
	40°-41°	124°-125°		
Methodist church	40 48 11.00	124 09 41.00	C. & G. S	
	39°-40°	120°-121°		
Mountain	39 54 32.20	120 05 43.20	Wheeler	Final Rept.
Hill	14 39.40	57 56.60	G. S	Bull. 122.
eak	21 48.60	20 47.30	Wheeler	Final Rept.
Peak	28 20.90	02 13.50	do	Do.
ville	35 29.80	38 39.30	do	Do.
Peak	08 32.10	30 33.90	G. S	Bull. 122.
e	43 43.50	51 10.30	do	Do.
Peak	39 40.70	33 01.00	Wheeler	Final Rept.
	59 33.70	37 40.10	G. S	Bull. 122.
	25 53.34	21 55.50	C. & G. S	
Peak	56 14.78	17 08.00	G. S	Do.
Peak	42 03.50	08 37.30	do	Do.
ak	06 39.30	13 56.30	do	Do.
ton Mountain	51 59.90	31 40.60	Wheeler	Final Rept.
	39°-40°	121°-122°		
Hill	39 46 32.70	121 25 40.00	G. S	Bull. 122.
	43 25.20	50 51.30	do	Do.
ille Butte	12 15.70	49 15.40	do	Do.
unty Peak	38 24.30	12 10.00	do	Do.
ountain	03 28.00	13 58.00	do	Do.
	38°-39°	119°-120°		
ak, Monument Peak	38 44 13.42	119 52 21.99	C. & G. S	
berg Peak	03 43.20	16 16.60	Wheeler	Final Rept.
elles Cone	24 11.50	52 20.70	G. S	Bull. 122.
t Mount	39 40.00	59 54.00	Wheeler	Final Rept.
eak, Jobs Peak	51 21.79	54 01.84	C. & G. S	
d Peak	32 31.94	45 21.40	G. S	Bull. 122.
an	40 54.70	36 43.70	do	Do.
ountain:				
th Peak monument	33 56.66	45 29.68	C. & G. S	
h Peak monument	32 31.94	45 21.31	do	Do.
	21 08.25	38 09.18	G. S	Bull. 122.
Mountain	43 52.90	58 44.40	Wheeler	Final Rept.
ater	26 07.60	18 19.60	C. & G. S	
	38°-39°	120°-121°		
ill	38 37 40.00	120 16 40.84	G. S	Bull. 122.
untain	54 09.20	42 19.20	do	Do.
eak	41 33.60	30 57.00	do	Do.
untain	01 08.50	35 08.40	do	Do.
untain	20 26.20	21 55.00	do	Do.
ista	16 06.80	54 51.80	do	Do.
n	27 49.20	32 01.00	do	Do.
	20 18.30	43 17.40	do	Do.
	08 15.20	41 24.90	do	Do.
nne Peak	32 12.12	05 41.34	do	Do.
l	43 04.40	59 26.70	do	Do.
l Mountain	50 32.60	09 20.60	Wheeler	Final Rept.
ak	55 24.30	24 14.00	G. S	Bull 122.
op	39 43.63	00 04.99	C. & G. S	
oaf	34 43.00	56 59.30	G. S	Do.
	34 30.70	29 38.10	do	Do.

CALIFORNIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	38°-39°	**122°-123°**		
	° ′ ″	° ′ ″		
Helena	38 40 04.26	122 38 01.41	C. & G. S.	
Sulphur Peak	45 46.74	50 40.84	do	
Vaco	22 27.02	05 05.61	do	
	38°-39°	**123°-124°**		
Ross Mountain	38 30 13.03	123 07 09.77	do	
Sanel	56 48.23	13 00.87	do	
	37°-38°	**118°-119°**		
McBride Peak	37 50 08.00	118 21 12.60	Wheeler	Final Rept
Morgan Mount	24 07.20	43 46.90	do	Do.
Waucoba Peak	01 07.80	00 23.20	do	Do.
White Mountain:				
North summit	50 13.77	21 26.34	C. & G. S.	
South summit	37 57.60	15 22.10	do	
	37°-38°	**119°-120°**		
Chiquita Peak	37 20 46.80	119 25 31.80	Wheeler	Do.
Clark Peak	41 42.00	25 44.10	G. S	Bull. 122.
Cloud Rest	45 53.20	29 11.80	Wheeler	Final Rept
Conness	57 55.97	19 18.10	C. & G. S.	
Cottonwood Peak	55 30.90	44 07.30	G. S	Bull. 122.
Dana	53 54.30	13 17.40	C. & G. S.	Do.
Deadwood Peak	18 36.70	41 00.20	Wheeler	Final Rept
Devils Peak	31 40.20	44 26.90	G. S	Bull. 122.
Engineer Peak	49 55.00	23 35.00	Wheeler	Rept. '79.
Green Mountain Peak	15 43.60	59 19.60	do	Do.
Hoffman	50 43.50	30 39.20	G. S	Bull. 122.
Lyell	44 16.60	16 19.00	do	Do.
Merced Mountain	37 54.90	23 30.60	Wheeler	Final Rept
Pilot Peak	45 39.80	56 10.90	G. S	Bull. 122.
Wade Peak	51 08.50	47 16.90	Wheeler	Final Rept
	37°-38°	**120°-121°**		
Big Canyon	37 58 01.50	120 07 13.00	G. S	Bull. 122.
Big Hill	49 37.30	34 08.80	do	Do.
Bullion Peak	33 27.60	04 33.70	do	Do.
Moccasin Peak	48 12.50	19 43.00	do	Do.
Schultz Mount	26 33.10	08 32.90	Wheeler	Final Rept
	37°-38°	**121°-122°**		
Hamilton	37 20 23.00	121 30 31.35	do	Do.
Mount Diablo	52 48.70	54 51.95	C. & G. S	
San Jose, mission church	32 00.08	54 10.27	do	
Santa Clara, Catholic spire	20 49.00	56 26.00	do	
	37°-38°	**122°-123°**		
Bald	37 52 56.19	122 13 20.48	G. S	Do.
Lawson Hill	56 34.00	11 36.00	do	Do.
Monument South	50 55.88	11 35.52	do	Do.
Mulholland Hill	51 26.00	08 36.00	do	Do.
Redwood Peak	49 00.00	10 37.00	do	Do.
Rocky Island	53 42.00	21 21.00	do	Do.
Striped Hill	56 49.00	17 17.00	do	Do.
Yerba Buena	48 30.00	21 59.00	do	Do.
	36°-37°	**117°-118°**		
Maturango Mountain	36 06 56.30	117 29 49.90	Wheeler	Do.
New York Butte	38 40.80	55 56.40	do	Do.
Telescope Mountain	09 52.40	05 27.20	do	Do.
Wahguyhe Mountain	56 03.50	06 15.60	do	Do.
	36°-37°	**118°-119°**		
Corcoran Mount	36 31 14.00	118 14 23.80	do	Do.
Olancha Peak	15 43.80	07 10.20	do	Do.
Thunder Mountain	04 52.20	34 40.70	do	Do.
Whitney Mount	34 33.00	17 32.00	do	Do.
	36°-37°	**119°-120°**		
Fresno	36 43 31.22	119 47 19.50	do	Repts.'79,'
	35°-36°	**117°-118°**		
Pilot Knob	35 23 32.10	117 13 49.70	do	Final Rep
	35°-36°	**118°-119°**		
Camp Weldon (mountain)	35 40 01.00	118 17 05.00	do	Do.
Cooks Point (mountain)	37 09.00	26 30.40	do	Do.
Nichols Point	37 00.50	18 05.20	do	Do.
Owens Peak	44 05.40	00 00.50	do	Do.
Pahute Peak	28 37.60	21 49.80	do	Do.
Sunday Peak	46 48.50	35 17.30	do	Do.
Tehachapai Double Peak	01 47.00	29 25.50	do	Do.
Tehachapai Mount	02 21.30	34 35.60	do	Do.
Grizzly Peak	05 52.70	50 54.70	do	Do.

CALIFORNIA—Continued.

Name.	Latitude.	Longitude.	Authority.	Reference.
	34°-35°	**117°-118°**		
	° ′ ″	° ′ ″		
	34 01 51.60	118 28 37.10	G. S	Bull. 122.
	00 58.00	46 54.00	do	Do.
	01 14.00	17 52.00	do	Do.
nio Peak	17 06.20	39 14.10	Wheeler	Final Rept.
	03 17.00	51 06.00	G. S	Bull. 122.
rry	13 49.00	14 10.00	do	Do.
	03 32.00	04 09.00	do	Do.
	34°-35°	**118°-119°**		
ntment Peak	34 14 49.80	118 06 54.80	Wheeler	Final Rept.
d	07 20.00	08 57.00	G. S	Bull. 122.
Malaga) Mountain	04 33.50	39 17.20	Wheeler	Final Rept.
ando Peak	19 39.30	36 01.90	do	Do.
se	16 00.00	14 19.60	do	Do.
n Hill	00 48.40	01 14.50	do	Do.
	34°-35°	**119°-120°**		
ount	34 48 43.90	119 08 52.60	do	Do.
ranite Mountain	36 34.00	07 55.10	do	Do.
	33°-34°	**116°-117°**		
	33 13 56.40	116 54 14.00	G. S	Bull. 122.
nto Mountain	49 07.90	42 22.20	Wheeler	Final Rept.
	00 25.10	58 17.80	G. S	Bull. 122.
	33°-34°	**117°-118°**		
ngs	33 57 36.10	117 16 54.00	do	Do.
	12 04.40	04 00.90	do	Do.
e	09 32.00	00 18.00	do	Do.
utte	43 21.00	07 28.00	do	Do.
	36 03.10	20 39.80	do	Do.
ob	12 38.10	11 06.50	do	Do.
	09 42.30	19 23.80	do	Do.
r	19 13.20	08 08.50	do	Do.
les, SE. base (1890)	47 28.38	56 36.08	C. & G. S	Do.
a	26 34.50	23 30.00	G. S	Do.
	17 54.40	16 14.70	do	Do.
	30 39.30	44 06.80	do	Do.
	21 44.80	29 45.50	do	Do.
uin	36 15.40	48 46.90	do	Do.
	54 43.90	44 21.08	C. & G. S	Do.
	42 32.40	32 07.00	G. S	Do.
Mountain	42 31.00	32 04.00	Wheeler	Rept. '79.
	06 25.90	09 22.20	G. S	Bull. 122.
	13 31.40	22 05.30	do	Do.
	33°-34°	**118°-119°**		
o Hill	33 44 39.20	118 20 07.80	Wheeler	Final Rept.
n	59 24.00	00 14.00	G. S	Bull. 122.
	32°-33°	**116°-117°**		
a	32 56 42.20	116 36 26.70	do	Do.
uel	41 41.00	56 14.00	do	Do.
	32°-33°	**117°-118°**		
	32 58 47.40	117 07 02.00	do	Do.
	48 39.90	01 58.00	do	Do.
o, transit	43 06.00	09 40.80	C. & G. S	Rept. '84.

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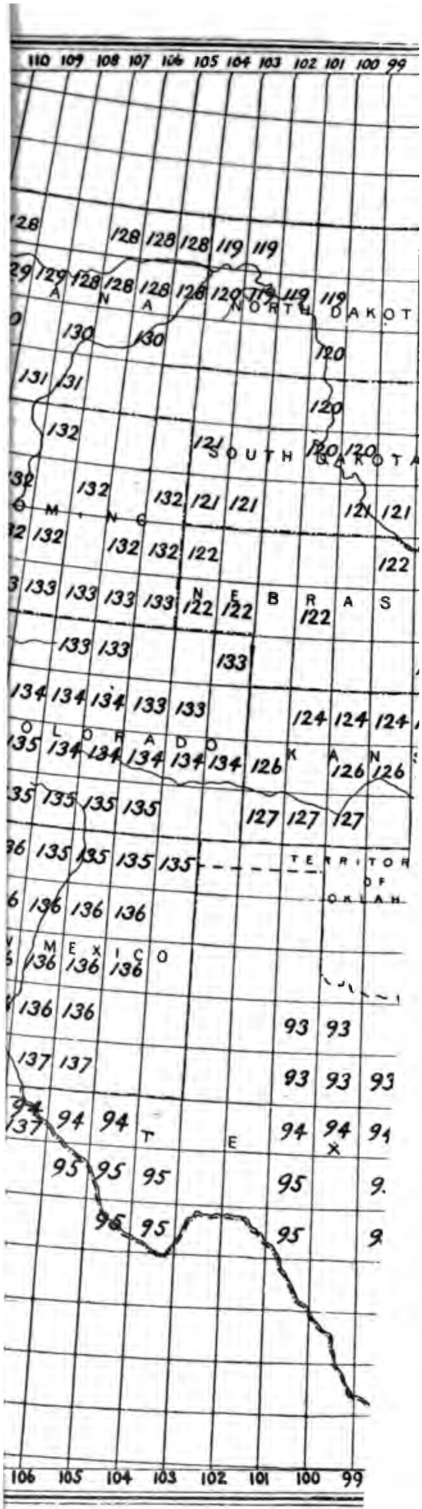

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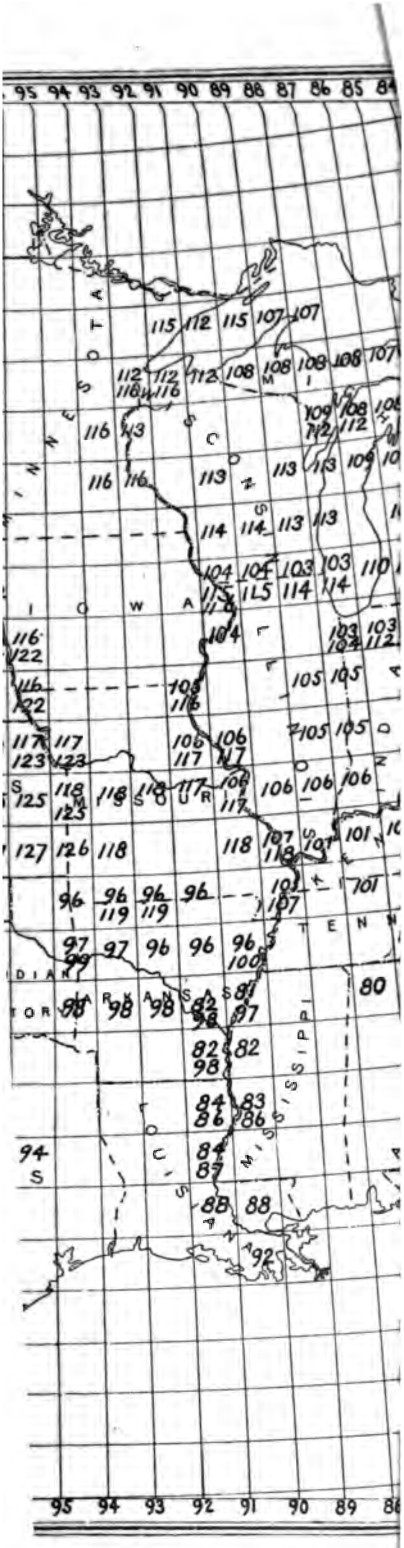

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LETTER OF TRANSMITTAL.

CAMBRIDGE, MASS., *November 7, 1893.*

SIR: I send herewith for publication as a bulletin, if acceptable to you, the manuscript of a paper, and drawings to illustrate it, upon the fossil cockroaches of North America. The paper was partially completed and most of the drawings were made at the termination of my connection with the Survey, and has since been finished in such leisure as I could command.

Yours, respectfully,

SAMUEL H. SCUDDER.

To the DIRECTOR U. S. GEOLOGICAL SURVEY,
Washington, D. C.

REVISION OF THE AMERICAN FOSSIL COCKROACHES.

By SAMUEL HUBBARD SCUDDER.

INTRODUCTION.

When, in 1879, I published my Paleozoic Cockroaches,[1] in which a revision of the species of the whole world was attempted, I had seen but nineteen specimens from North America, belonging to seventeen species and seven genera. To-day more than three hundred American specimens have passed under my eye, besides fifty from the Triassic rocks and a very few from the Tertiary series; and from the Paleozoic series alone there are here recognized one hundred and thirty-two species (not including some indeterminate forms) belonging to fourteen genera. As I have published from time to time in various places, but principally in the Memoirs of the Boston Society of Natural History (collected in Vol. I of my Fossil Insects of North America), a considerable number of species, and as a still larger number have since accumulated, thanks to recent exploitation of the Carboniferous deposits of eastern America, it has seemed advisable, in publishing the new forms, to bring together, either by reference or by description and figure, the whole body of information at present available, in order to gain a place for a new departure.

Accordingly, I have interpolated the descriptions of new forms in a systematic list of all the species yet recovered from the rocks and have added such tables as may enable one the more readily to determine any new material that may come to hand and to make comparisons with such as prove their nearest allies. With the publication of this essay, moreover, all the species hitherto described will have been figured. All the additions made at the present time belong to the Paleozoic forms. Several species before described are here figured for the first time.

NEW LOCALITIES FOR FOSSIL COCKROACHES.

The recent extension of our knowledge of our Paleozoic cockroaches is very largely due to the exploitations of two localities, one in West Virginia, through the instrumentality of Mr. R. D. Lacoe, of Pittston, Pa., the other in Ohio, through the labors of Mr. Samuel Huston, of Steubenville.

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[1] Mem. Bost. Soc. Nat. Hist., III, 23-134, pl. 2-6; Foss. Ins. N. A., I, 43-153, pl. 2-6.

The West Virginia locality is at Cassville, Monongalia County, not far from Morgantown, and the specimens were found in rocks lying above the Waynesburg coal, in what is termed by Prof. I. C. White the Dunkard Creek series, and referred very positively by him and Prof. W. M. Fontaine to the Permian. The blattarian fauna as thus far determined is unquestionably younger than any known from the Pennsylvania and Illinois rocks, on which we have hitherto depended largely for our knowledge, and consists of a vast assemblage of forms, which will undoubtedly be increased by further search. They number fifty-six species, belonging to five genera, the bulk of them (thirty-six species) to Etoblattina.

The Ohio locality lies at the edge of the township of Richmond, on Wills Creek, in the near neighborhood of Steubenville, Jefferson County, and though far less extensive and less thoroughly worked than Cassville, has already yielded twenty-two species belonging to three genera, of which the larger number (seventeen) belong to Etoblattina and the others to the genera represented at Cassville by more than a single species.

It is a curious fact, to which I called partial attention when first describing some of them, that these species represent for the most part a distinct group of cockroaches of the genera Etoblattina and Gerablattina, characterized by great length and slenderness of the internomedian area, by a remarkable openness of the neuration in the middle of the tegmina, and by their frequently exceptional length and slenderness. They comprise, indeed, nearly 75 per cent of the species in these two genera at Richmond, and hardly occur elsewhere excepting at Cassville, where they compose about 25 per cent of the species of these two genera. The only occurrence of a similar form in Europe is *Etoblattina elongata* from the lower Dyas of Weissig, Saxony. The occurrence of this type of cockroaches is the characteristic feature of Richmond, and must place this fauna high in the series, as the stratigraphical evidence itself warrants. Its horizon, according to Mr. Huston, who alone has carefully explored the location, is in the Barren Coal-measures, a little above the crinoidal limestone.

It is remarkable that, notwithstanding the close relationship in general features of the two rich faunas of Cassville and Richmond, not a single species has been found common to the two. One species, indeed, I formerly regarded as found in both, but a closer study convinces me that there are in this case two very nearly allied forms, and they are accordingly separated in the present paper. Further than this, with one or two exceptions,[1] no American species has been found in two different places, and without exception the American species are completely distinct from the European.

---

[1] One of these is *Etoblattina balteata*, in which a fragment consisting of the anal area of the tegmina, from Bellaire, Ohio, is referred to one of the tegmina (without the anal area preserved) from Cassville, W. Va.

FAUNAL LISTS OF AMERICAN PALEOZOIC COCKROACHES.

The enlargement of our vision is, however, not entirely due to the new forms from Cassville and Richmond, but also to the increase in the number of species known from old horizons. Thus the Rhode Island coal field has now furnished a dozen species, including a new genus, while new localities in the Western Interior coal basin have increased their fauna to seven species, and certain additions have been made to other faunas already partially known. The following lists of faunas will prove of interest and show the geographical distribution of the species:

The Western Interior coal field.

Promylacris harei (Mo.).
Paromylacris clintoniana (Mo.).
Etoblattina clintoniana (Mo.).
venusta (Ark.).
Etoblattina occidentalis (Kans.).
Anthracoblattina americana (Mo.).
Oryctoblattina laqueata (Mo.).

The Eastern Interior coal field (Illinois).

Mylacris elongata.
anthracophila.
gurleyi.
ampla.
antiqua.
Promylacris testudo.
ovalis.
rigida.
Paromylacris rotunda.
Paromylacris ampla.
triangularis.
Lithomylacris simplex.
Archimylacris paucinervis.
Etoblattina mazona.
hilliana.
Progonoblattina columbiana.
Oryctoblattina occidua.

The Acadian coal field.

Mylacris bretonensis.
heeri.
Archimylacris acadica.
Petrablattina sepulta.

The Rhode Island coal field.

Mylacris packardii.
Microblattina perdita.
Etoblattina illustris.
scholfieldi.
clarkii.
sp.
Etoblattina gorhami.
exilis.
reliqua.
latebricola.
Gerablattina scapularis.
fraterna.

The Appalachian coal field (Pennsylvania).

Mylacris priscovolans.
lucifuga.
carbonum.
pennsylvanica.
mansfieldi.
ovalis.
Paromylacris pluteus.
Lithomylacris angusta.
Lithomylacris pittstoniana.
pauperata.
Necymylacris lacoana.
heros.
Archimylacris parallela.
Etoblattina lesquereuxii.
Gerablattina fascigera.

The Barren Coal-measures at Richmond, Ohio.

Etoblattina fossa.
strigosa.
jeffersoniana.
fasciata.
ramosa.
willsiana.
maledicta.
benedicta.
funesta.
exsensa.
tenuis.
Etoblattina hustoni.
hastata.
marginata.
gracilenta.
stipata.
variegata.
Gerablattina apicalis.
richmondiana.
minima.
Poroblattina longinqua.
ohioensis.

The Dunkard Creek series at Cassville, W. Va.

Etoblattina lata.
sagittaria.
mediana.
ovata.
debilis.
balteata.
patiens.
mucronata.
detecta.
exigua.
residua.
funeraria.
expuncta.
aperta.
eakiniana.
accubita.
expulsata.
gratiosa.
macerata.
immolata.
mactata.
communis.
exsecuta.
arcta.
prædulcis.
angusta.
macilenta
rogi.
Etoblattina expugnata.
obatra.
imperfecta.
secreta.
invisa.
occulta.
defossa.
recidiva.
Gerablattina inculta.
perita.
diversinervis.
cassvici.
abdicata.
concinna.
uniformis.
permanenta.
permacra.
eversa.
deducta.
radiata.
lata.
rotundata.
ovata.
Anthracoblattina virginiensis.
Poroblattina gratiosa.
fossa.
complexinervis.
Petrablattina hastata.

TABLES OF DISTRIBUTION OF AMERICAN AND EUROPEAN FOSSIL COCKROACHES.

The following table presents in a summary form the number of species of the different genera of cockroaches found in the American Paleozoic rocks in each of the different coal basins and in the two special localities in Ohio and West Virginia where the greatest number of species have been found. It summarizes the foregoing lists. The horizontal line separates the Mylacridæ and Blattinariæ.

Table showing the geographical distribution of the American Paleozoic genera.

Genera.	Western Interior (Missouri, Arkansas, Kansas).	Eastern Interior (Illinois).	Acadian (Nova Scotia, Cape Breton).	Rhode Island.	Appalachian (Pennsylvania).	Richmond, Ohio.	Cassville, W. Va.	Total.
Mylacris		5	2	1	6			14
Promylacris	1	3						4
Paromylacris	1	3			1			5
Lithomylacris		1			3			4
Necymylacris					2			2
Microblattina				1				1
Archimylacris		1	1		1			3
Etoblattina	8	2		8	1	17	36	67
Gerablattina				2	1	3	15	21
Anthracoblattina	1						1	2
Progonoblattina		1						1
Oryctoblattina	1	1						2
Poroblattina						2	3	5
Petrablattina			1				1	2
Total	7	17	4	12	15	22	56	133

The fact that, with the very considerable increase shown to have been made in the number of known species, hardly a single one of them has been found at two distinct localities, lends importance to the right determination of the horizon at which each species has been found and renders probable, with the further extension of our knowledge of their distribution, the advantageous use of these fossils in delicate discriminations of the age of rock deposits. Accordingly, as a first step in this direction, I have drawn up the succeeding table, showing the relative geological age of each of the American species, the species themselves being arranged systematically, but excluding from the list, as at present unimportant, the three Tertiary species. In this table I have roughly separated the species from the true productive Coal-measures, i.e., above the "Millstone Grit" and below the "Barren Coal-measures," into an upper and lower series, endeavoring as far as possible to make the latter correspond to the coals A–C, inclusive, of the Pennsylvania series, and where the reference was at all doubtful to indicate it in the table by a mark of interrogation instead of the usual cross.

Horizontal distribution of the American pre-Tertiary cockroaches.

Species.	Millstone Grit.	Lower Productive Coal-measures.	Upper Productive Coal-measures.	Barren Coal-measures.	Permian.
Mylacris packardii		?			
bretonensis			?		
elongata		×			
anthracophila		×			
gurleyi		×			
ampla		×			
priscovolans		×			
heeri			?		
antiqua		×			
lucifuga			×		
carbonum		×	×		
pennsylvanica		×			
mansfieldi		×			
ovalis		×			
Promylacris harei				×	
testudo		×			
ovalis		×			
rigida		×			
Paromylacris rotunda		×			
ampla		×			
triangularis		×			
clintoniana		×			
pluteus			×		
Lithomylacris angusta			×		
pittstoniana			×		
pauperata			×		
simplex		×			
Necymylacris lacoana		×			
heros		×			
Microblattina perdita		?			
Archimylacris parallela	×				
paucinervis		×			
acadica			×		
Spiloblattina gardineri					
triassica					
guttata					
marginata					
Etoblattina clintoniana		×			
lata					×
sagittaria					×
mediana					×
fossa				×	
illustris		?			
ovata					×
scholfieldi		?			
debilis					×
strigosa				×	
clarkii		?			
venusta	?				
balteata				?	×
patiens					×
mucronata					×
detecta					×
occidentalis			?		
exigua					×
sp. (R. I.)		?			
jeffersoniana				×	
residua					×
funeraria					×
expuncta					×
gorhami		?			
aperta					×
fasciata				×	
ramosa				×	
willsiana				×	
lesquereuxii			×		
maledicta				×	
benedicta				×	
funesta				×	
exsensa				×	
tenuis				×	
hustoni				×	
persistens					
eakiniana					×
accubita					×
mazona		×			

Horizontal distribution of the American pre-Tertiary cockroaches—Continued.

Species.	Millstone Grit.	Lower Productive Coal-measures.	Upper Productive Coal-measures.	Barren Coal-measures.	Permian.	Trias.
Etoblattina expulsata					×	
gratiosa					×	
macerata					×	
immolata					×	
mactata					×	
communis					×	
sp. (Colo.)						×
hastata				×		
marginata				×		
gracilenta				×		
exsecuta					×	
arcta					×	
stipata				×		
prædulcis					×	
variegata				×		
hilliana		×				
angusta					×	
macilenta					×	
exilis		?				
rogi					×	
expugnata					×	
obatra					×	
imperfecta					×	
secreta					×	
reliqua		?				
invisa					×	
occulta					×	
latebricola		?				
defossa					×	
recidiva					×	
Gerablattina inculta					×	
perita					×	
apicalis				×		
diversinervis					×	
richmondiana				×		
cassvici					×	
abdicata					×	
concinna					×	
uniformis					×	
permanenta					×	
permacra					×	
eversa					×	
deducta					×	
scapularis		?				
fraterna		?				
radiata					×	
lata					×	
rotundata					×	
ovata					×	
minima				×		
fascigera	×					
Anthracoblattina americana		×				
virginiensis					×	
Progonoblattina columbiana		×				
Oryctoblattina occidua		×				
laqueata				×		
Poroblattina longinqua				×		
gratiosa					×	
fossa					×	
meieri						×
arcuata						×
lakesii						×
ohioensis				×		
complexinervis					×	
Petrablattina sepulta		×				
hastata					×	
æqua						×
Neorthroblattina albolineata						×
lakesii						×
rotundata						×
attenuata						×
Scutinoblattina brongniarti						×
intermedia						×
recta						×

With this may be compared the next table, in which I attempt a similar division of the described European species, separating them by the zones employed by Dr. H. B. Geinitz in his Steinkohlen Deutschlands (1865), his Zone I (which does not come into use here, and which I take to be the equivalent of our Millstone Grit), being the "Hauptzone der Lycopodiaceen;" II, "der Sigillarien;" III, "der Calamiten;" IV, "der Annularien;" V, "der Farren;" succeeded by the Dyas or Permian. I have been aided by Kliver's tabulation of the species found in the Saarbruck basin (Palæontographica, XXIX, 264–265), whose separation of the "upper" and "middle" coal formation falls, Dr. Geinitz informs me, near the middle of Zone IV. The Löbejün basin, he tells me, belongs by its sigillarians to the middle coal formation, but is at the same time scarcely separable from that of Wettin, which on its part closely agrees with that of Manebach, etc., and must be regarded as of the upper coal formation. In the following table I have placed all of the species from Löbejün and Wettin in Zone IV, and those of Manebach in Zone V., but classed them both as of the upper coal formation.

European Palaeozoic cockroaches.

Middle Carboniferous.		Upper Carboniferous.		Dyas.
Zone II.	Zone III.	Zone IV.	Zone V.	
Etobl. bituminosa. mantidioides.[1] johnsoni.[1] deanensis.[1] steinbachensis.[2]	Etobl. primæva.	Etobl. didyma.[3] affinis.[3] anaglyptica.[3] carbonaria.[3] dohrnii.[3] flabellata.[3] euglyptica.[3] leptophlebica.[3] parvula.[3] russoma.[3] propria. lanceolata.[3]	Etobl. didyma. intermedia. labachensis. manebachensis.	Etobl. elongata. weissigensis. dyadica. stelzneri. deichmülleri. flabellata. ornatissima.
Gerabl. scaberata.		Gerabl. geinitzi.[3] germari.[3] münsteri.[3] producta.[3]	Gerabl. clathrata. goldenbergi. mahri. weissiana. robusta.	Gerabl. rollei.
Anthracobl. incerta. winteriana. camerata. lubnensis.		Anthracobl. wagneri.[3] spectabilis[3].	Anthracobl. remigii. dresdensis. scudderi.	Anthracobl. porrecta. spectabilis? rückerti. sopita.
			Hermatobl. kirkbyi.[4] wemmetsweileriensis.	Hermatobl. lebachensis.
Progonobl. helvetica.[1]			Progonobl. fritschii.	
		Oryctobl. arndti.[3] reticulata.[3]		Oryctobl. oblonga.
				Petrabl. gracilis.
Leptobl. insignis. exilis.[1]				

[1] Certainly belonging to the Middle Carboniferous and probably to Zone II.
[2] Placed here by presumption only; it may belong to the Upper Carboniferous.
[3] Belonging to the Upper Carboniferous and probably to Zone IV.
[4] Credited to the Upper Carboniferous, but perhaps belonging in Zone IV.

Finally, the following table may be of interest, in which a provisional attempt is made to correlate in a summary way the details of the foregoing tables. It indicates merely the presence of the different genera of fossil cockroaches in the several periods from which they are known, whether in Europe (by the letter E in the horizons in which they occur) or in America (by the letter A). It includes all the known described Palæoblattariæ of the world, with the addition of the fossil Neoblattariæ of North America only. The numerous Liassic forms of Europe are therefore omitted. For convenience the Mylacridæ are separated by a horizontal line from the Blattinariæ, and the Neoblatariæ from the Palæoblattariæ.

Geological distribution of the genera of fossil cockroaches.

Genera.	Millstone Grit.	Lower Productive Coal-measures.	Higher Productive Coal-measures.	Barren Coal-measures.	Permian.	Trias.	Tertiary.	Present epoch.
Mylacris	....	A	A	....	....	....	....	....
Promylacris	....	A	....	A	....	....	....	....
Paromylacris	....	A	A	....	....	....	....	....
Lithomylacris	....	A	A	....	....	....	....	....
Necymylacris	....	A	....	....	....	....	....	....
Microblattina	....	A	....	....	....	....	....	....
Archimylacris	A	A	....	....	....	....	....	....
Spiloblattina	....	....	....	....	....	A	....	....
Etoblattina	A[1]	A E	A	A E	A E	A	....	....
Gerablattina	A	A E	....	A E	A E	....	....	....
Anthracoblattina	....	A E	....	E	A E	....	....	....
Hermatoblattina	....	....	....	E	E	....	....	....
Progonoblattina	....	A E	....	E	....	....	....	....
Oryctoblattina	....	A	E	A	E	....	....	....
Poroblattina	....	....	....	A	A	A	....	....
Petrablattina	....	A	....	....	A E	A	....	....
Leptoblattina	....	E	....	....	....	....	....	....
Neorthroblattina	....	....	....	....	....	A	....	....
Scutinoblattina	....	....	....	....	....	A	....	....
Zetobora	....	....	....	....	....	....	A	A
Homoeogamia	....	....	....	....	....	....	A	A
Paralatindia	....	....	....	....	....	....	A	A

[1] Subject to correction as noted on pp. 60, 73.

THE RAPID INCREASE IN OUR KNOWLEDGE.

The relative increase of our knowledge of the Paleozoic cockroaches of Europe and America can best be shown by the following table, in which the number of species of each genus on each continent, as shown in my first work on the subject and at the present time, are placed in separate columns:

Genera.	Europe.		America.		Total.	
	1879.	1893.	1879.	1893.	1879.	1893.
Mylacris	0	0	5	14	5	14
Promylacris	0	0	0	4	0	4
Paromylacris	0	0	0	5	0	5
Lithomylacris	0	0	3	4	3	4
Necymylacris	0	0	2	2	2	2
Microblattina	0	0	0	1	0	1
Archimylacris	0	0	2	3	2	3
Etoblattina	18	27	2	67	20	94
Gerablattina	10	11	2	21	12	32
Anthracoblattina	7	11	0	2	7	13
Hermatoblattina	2	3	0	0	2	3
Progonoblattina	2	2	0	1	2	3
Oryctoblattina	1	3	0	2	1	5
Poroblattina	0	0	0	5	0	5
Petrablattina	1	1	1	2	2	3
Leptoblattina	0	2	0	0	0	2
Total	41	60	17	133	58	193

While the total number of species has thus more than trebled, the European species have increased about 50 per cent while the American species have multiplied nearly eightfold. It should not be overlooked, however, that a very different result would unquestionably appear if the Commentry cockroaches, which Brongniart announced in 1889 had then been found to the number of more than 600, had been published. Unfortunately not a single one has yet been described.

This table shows also the genera which are known from Europe and America and permits a ready comparison between the representation of the genera on the two continents. It shows that in each Etoblattina and Gerablattina easily hold the first place and that Etoblattina is especially rich in forms, containing just about one-half the species of either continent. It also makes conspicuous a point to which I called attention in my first essay on Paleozoic cockroaches—that the Mylacridæ, comprising nearly 22 per cent of the species and five of the fourteen genera in America, are, so far as described forms are concerned, completely absent from Europe.

SOME CHARACTERISTICS OF MYLACRIDÆ.

This, however, it appears, is not a statement of the actual fact; for, in a brief note on Carboniferous cockroaches published in the Comptes rendus of the French Academy for February 4, 1889, Mr. Charles Brongniart states that Mylacridæ are as abundant as Blattinariæ at the famous locality at Commentry, France, although the latter only have hitherto been found fossil in other places in the European Coal-measures. Brongniart gives neither description nor figures in support of this statement, but points out from the uncommonly well-preserved specimens found at Commentry what he regards as further points of distinction between the Mylacridæ and Blattinariæ, drawn from the structure of the thorax: the prothoracic shield of the Blattinariæ being well rounded and narrower than the body including the folded wings, while that of the Mylacridæ is broader than the stout body, and, instead of being rounded, is nearly in the form of a triangle, its base forward.

These distinctions can not be maintained for the American forms. Although specimens of either group showing anything more than the tegmina are rare in the American rocks, a few have been found and have been published, while still others are made known in the present paper. In no case do those show a prothorax wider than the folded wings, although in some, notably in *Promylacris testudo*, the prothorax is nearly as wide; nor in any of the Mylacridæ, where a subtriangular form is more common than in the Blattinariæ, is the broadest portion in advance of the middle, as must be the case if in the form of a triangle its base forward (il a presque la forme d'un triangle à base située en avant), but always behind it.

Stated broadly, the Mylacridæ are usually stouter bodied than the Blattinariæ (though the species of Lithomylacris are usually as slender as most Blattinariæ), and the prothoracic shield is usually, but not always, broader in proportion to its length in the Mylacridæ and is not unfrequently subtriangular, by the subangular projection of the middle of the front border, and of the extreme sides of the posterior margin. An excellent illustration of this is seen in *Paromylacris rotunda* and in *Promylacris rigida* (Pl. III, fig. 1), in which latter the form of the prothorax is very different from the transverse suboval of its congener *P. testudo*. A publication of the different forms of Mylacridæ alleged to be found at Commentry is therefore all the more to be desired, and it is much to be hoped that Mr. Brongniart will favor the world at an early day with further and fuller details regarding the superb collections in his hands. They can not fail to throw much light upon our knowledge of the earlier insects. The only specimens I have myself seen from Commentry (a photograph and a very perfect fore wing) are Etoblattinæ.

Before proceeding to the special description of the new American forms, there are a few matters which I will consider under separate heads, as follows:

1. The relative size of ancient cockroaches.
2. The features of a nearly complete body of a Carboniferous cockroach from Illinois.
3. The hind wings of Paleozoic cockroaches.
4. Possible mimicry in Paleozoic cockroaches.
5. The European species of Etoblattina, with description of a new form.
6. A list of the described European Paleozoic cockroaches.
7. The terminology of the neuration.

1. THE RELATIVE SIZE OF ANCIENT COCKROACHES.

No one can handle many Paleozoic cockroaches without being struck by the fact that they are of large size. I drew attention to this in my Paleozoic Cockroaches, remarking that "while the average was considerably above that of existing cockroaches, none were much larger than some South American species of Blabera," whose tegmina sometimes attain a length of 60 to 70 mm. But in the present paper a fragment of a fore wing is described, which, when perfect, must have measured 80 mm. in length. In an estimate from the then known species of Paleozoic cockroaches, I stated that "the average length of the front wing appears to have been about 26 mm."

Since then the increase in the number of species in this country has been largely from the younger Paleozoic rocks, and if we were to add the Triassic Palæoblattariæ, of still smaller size, we should find that the average length of the fore wing in ancient American cockroaches, 133 species in all, was 23.2 mm. The Mylacridæ were larger, on the average, than the Blattinariæ, a fact due in great part to the younger cockroaches being all Blattinariæ, for the tegmina of 29 Mylacridæ average 27.5 mm., while those of 104 Blattinariæ average 22 mm. only. That even this last figure is larger than the average size of living cockroaches, one familiar with the latter would readily venture to assert; but to put it to a fair test, I have estimated the average size of recent species from the measurements given in Brunner's Système des Blattaires (1865), the last general work on the subject. About 380 species are included in this work, but of only 239 are measurements given of the length of the tegmina; where different measurements are given for the two sexes I have uniformly chosen that for the male as in general the larger; and where the measurements covered a range I have taken the exact mean. In this way I estimate the average length of the tegmina of living cockroaches to be 18.8 mm., which is markedly less than the size of the Paleozoic forms.[1]

This, however, is by no means the whole of the story. I have further tabulated separately the length of the tegmina for the different American species from the Millstone Grit to the Trias, inclusive, and find that there is a marked and regular diminution in average size from one period to another, as will appear from the following measurements of the tegmina given in millimetres:

Millstone Grit (3 species), 26 to 38, average 31.

Lower Productive Coal-measures (39 species), 10 to 61, average 29.7.

Upper Productive Coal-measures (12 species), 16.35 to 33, average 26.4.

Barren Coal-measures (23 species), 9.75 to 31.5, average 23.4.

Permian (56 species), 8.25 to 28.75, average 16.9.

Trias (17 species), 6.3 to 24, average 13.

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[1] In making this estimate, though I recollected I had once made one of the same nature, I had forgotten its publication, and only after the above was written discovered it in my Revision of Mesozoic Cockroaches, where a slightly different result follows slightly different data; but I prefer to leave the above as it stands.

The only important doubt about the exact accuracy of this ment is that the fauna of the Rhode Island coal basin (consisti 12 species) is included in the Lower, when it may perhaps belo the Upper Productive Coal-measures. The average size of the Island species is 27.3 mm., and that of the species from the Lowe ductive Coal-measures without them is 30.7 mm., while, if the Island species were added to the Upper series, it would increa average of that to 26.8 mm.; but this would still not disturb the lar succession of averages. The average size of the 50 specie the Productive Coal-measures as a whole is 27.4 mm., or almos cisely that of the Rhode Island species alone.

I do not mean to maintain that the size of cockroaches ha steadily and continuously diminishing from the earliest times present, but only for that period of time which is here considere also, I may add, for the later Mesozoic rocks, for I have formerly that the average length of the tegmina of European Mesozoic (n Liassic) cockroaches was 12.5 mm., which is slightly less than t the species from the American Trias. It is well known that the mass of Mesozoic, and especially Liassic, insects were of small but the insects of the Tertiaries did not differ in this respect i noticeable degree from those now living.

I have further tabulated the relative length of the tegmina i different genera separately, both as a whole and in each of the p in which they occur. They may be shown as follows, the figures given in millimeters, and showing both range and average:

Average length of tegmina in the genera of American fossil cockroaches.

Genera.	Mill-stone Grit.	Lower Productive Coal-measures.	Upper Productive Coal-measures.	Barren Coal-measures.	Permian.	Trias.	I
Mylacris		26.50–42.00 Aver. 31.10	16.35–33.00 Aver. 25–60				16. Av
Promylacris		19.00–29.00 Aver. 25.30		17.50			17. Av
Paromylacris		21.00–42.00 Aver. 28.50	30.00				21. Av
Lithomylacris		24.00	26.00–29.25 Aver. 27.20				24. Av
Necymylacris		25.00–48.00 Aver. 36.50					25. Av
Microblattina		8.00					
Archimylacris	26.00	26.00–30.50 Aver. 28.25	23.00				23. Av
Spiloblattina						15.00–18.00 Aver. 16.40	15. Av
Etoblattina	29.00	14.25–61.00 Aver. 26.40	25.00–32.00 Aver. 28.50	14.00–31.00 Aver. 25.50	11.75–28.75 Aver. 17.60	12.00–20.00 Aver. 16.00	11. Av
Gerablattina	38.00	18.00–41.00 Aver. 29.50		9.75–25.00 Aver. 18.30	10.00–25.50 Aver. 16.60		9. Av
Anthracoblattina		30.00			12.00		12. Av
Progonoblattina		20.75					
Oryctoblattina		19.00		21.00			19. Av
Poroblattina				11.00–22.00 Aver. 16.50	13 50–16.75 Aver. 15.60	10.00–19.00 Aver. 13.70	10. Av
Petrablattina		13.00			8.25	24.00	8. Av
Neorthroblattina						8.50–12.00 Aver. 9.60	8. A
Scutinoblattina						6.30–7.00 Aver. 6.80	6 A

This table shows that in general, especially where the species were numerous, the same rule holds remarkably under each genus, the average size decreasing with the lapse of time. The only noticeable exception is in the two divisions of the Productive Coal-measures, where, in the genera Paromylacris, Lithomylacris, and Etoblattina, the averages are reversed from what they should be under the rule. The other exceptions, as in Oryctoblattina, and in part in Petrablattina, and in Archimylacris, are where only a couple of species or so are concerned. The relative average size of the species of the different genera is also shown, and proves that the average size of every genus of Mylacridæ is larger than that of any of the other genera excepting only Archimylacris, which, as I have elsewhere pointed out, was the most antique type of all cockroaches. The table further lends support to the view that the Dunkard Creek series of rocks (at Cassville) are older than the Barren Coal-measures, and should be referred to the Permian, since in each of the three genera represented in both beds the average size of the species from the Dunkard Creek series is the smaller.

II. THE BODY OF A PALEOZOIC COCKROACH.

Pl. XII, figs. 8–11.

Through the kindness of Prof. Josua Lindahl, of the Illinois Museum of Natural History, I have been permitted twice to examine a very curious specimen, which I regard as the principal part of the body of a wingless cockroach from the Coal-measures of Illinois. It is entirely freed from the matrix, and, with the exception of the head and appendages of the body, represents the complete body of a cockroach, probably in very much of its original form. The proportions of the abdomen indicate that it was in all probability a female, but whether a larval form or a mature individual with the wings removed is quite impossible to say. If a female, the ovipositor, said by Brongniart to be characteristic of Paleozoic cockroaches, is broken away. Fig. 9 is presumed to represent the ventral and fig. 11 the dorsal aspect of the creature, partly from the form of the upper surface of the metathorax, as shown particularly in fig. 10, and from the fact that there are what are apparently scars at the position of the mesothoracic coxæ on the ventral surface, which, however, do not clearly appear in the figure. The abdomen is composed of eight complete segments, similar dorsally and ventrally, as may best be seen by fig. 10. The first segment encircles the whole body externally, and is not covered at the sides by the projecting margins of the metathorax, as in modern cockroaches. There are, however, several anomalies in the abdomen and difficulties to be explained. Fig. 11 represents the dorsal aspect with the only clear indications, as shown also in fig. 10, of the separation of the mesothorax and metathorax, but with a distinct indication throughout of the first abdominal segment, which scarcely shows on the ventral aspect (fig. 9), and the difference in the separation of which from the metathorax o the dorsal and ventral surfaces is clearly shown in fig. 8. The secon and seventh abdominal segments are the only ones which are clearl distinct upon both margins throughout the entire circuit of the bod as shown in all the figures. The third and fourth segments are clearl distinct on the dorsal surface, but on the ventral (fig. 9) the distinctio between the third and fourth is lost, excepting on the right, whe it is as distinct as above; possibly the remaining portion of the thi segment may be broken away. Dorsally, the fifth segment is travers by an oblique fold, which does not appear elsewhere, and makes apparent separation of the segment into two subsegments. Simil indications, which only traverse a portion of the body, elsewhe appear, and the relation of the other parts to one another renders clear that there is here no true subsegmentation. The apparent di sion of the eighth segment in fig. 10 is explained by the other figur which show that this segment is made up in the original of a bundle irregular bosses which may have terminated (as Brongniart descri for the better preserved specimens of fossil cockroaches from the Coal measures of Commentry, France) with a long ovipositor, similar to those of our living Phasmidæ.

The abdomen is thus seen to differ from that of modern cockroaches in being composed of eight complete and tolerably uniform rings with no distinct separation, as may best be seen in fig. 10, into dorsal and ventral scutes, and in consequence there are as many ventral as dorsal, excepting only that the first segment is separated from the metathorax distinctly only on the dorsal surface, as is best seen in fig. 8. This may be the first step in a distinction between the dorsal and ventral surfaces as seen in modern cockroaches. But there is a further indication of something similar in the fold upon the dorsal surface of the fourth abdominal segment, indicating a division into subsegments at this point. In this case, however, the difference between the dorsal and ventral surfaces would appear to result from a division of one of the dorsal scutes rather than from a suppression of one of the ventral.

As it is impossible to determine to what genus this fragment may have belonged, or even to what family of ancient cockroaches, no name is given to it at present. It was obtained at Olney, Ill., by Mr. B. E. Phillips, and was presented by him to the Illinois Museum of Natural History, where it bears the number 4941.

III. THE HIND WINGS OF PALEOZOIC COCKROACHES.

Pl. XII, figs. 4–7.

By far the larger part of the remains of fossil cockroaches consist of the tegmina, but in a few instances the hind wings have been preserved, sometimes by themselves, sometimes in connection with the tegmina; and, as a few additional forms are illustrated in the present paper, it may be well to draw general attention to them more carefully than has yet been done.

On previous occasions I have mentioned the undoubted fact that the fore and hind wings of Paleozoic insects harmonized in neuration more completely than they do in living insects, and have also stated that even differentiation in texture, such as exists to-day in many groups (especially the lower), had scarcely begun, the neuration being always equally apparent in both wings. That this latter statement is not absolutely true for Paleozoic insects, that their fore wings were of somewhat denser texture or tougher consistency than the hind pair, must, I think, be conceded, when we note how extremely rarely the hind wings are preserved, as compared with the fore wings; nevertheless, when they are preserved, no such difference is discernible.

How rarely the hind wings of Paleozoic cockroaches are known may be quickly made apparent by the statement that up to the present time they have been figured for only three European species, two of Etoblattina and one of an undetermined form (*Blattina latinervis*) and for five American, namely, one species each of Promylacris, Paromylacris, Archimylacris, Oryctoblattina, and Etoblattina, to which are added in the present paper one each of Mylacris and Etoblattina, and two others of independent wings, one of which may be referred to Etoblattina, while the other, though nearly perfect, is very problematical. Those which are preserved in connection with other parts rarely show much beside the apical third, so that our knowledge of them is less advanced than it ought to be when they are thus so much more readily determinable. From this meager showing the following statements may be made, though they are offered with some hesitation, from the fragmentary material on which they are based:

It seems probable from the general harmony between the fore wings and the hind pair that a difference somewhat similar to that which exists between the fore wings of Mylacridæ and Blattinariæ will be found in the hind wings. In no case, however, have we yet found the costal margin of the hind wing preserved in any of the Mylacridæ; but in several of the Blattinariæ we see the mediastinal area stretching as a very narrow vittate field much more than half way to the apex of the wing, much narrower than is usual in the fore wing; while analogy would lead us to infer that in the Mylacridæ it was relatively much shorter and perhaps to a greater or less degree triangular. This is my sole reason for believing it probable that the wing figured on Pl. XII, fig. 5, is one of the Blattinariæ, to which is opposed the close resemblance it bears, in parts which allow of any comparison at all, to Promylacris, its excessive size, and the general composition of the fauna from which it comes, as will be stated later in the special description of this wing.

As a general rule the internomedian area, on the contrary, appears to have been broader than in the tegmina, and did not possess the special character of distinction from the mode of branching in the other areas which it had in the fore wing. In the latter, for instance, the branches of this area are generally much more delicate than in the other areas, and are usually more widely separated and very uniform. In all the hind wings where this area is preserved the branches are in no way more delicate than those of the other areas, while, with the exception of Mylacris, the branches are as close as elsewhere, and usually somewhat or considerably irregular. Curiously, in Mylacris the general appearance of this area is precisely as in the fore wing, differing apparently only in being narrower and tapering less rapidly. The other intermediate areas of the hind wing differ from their general character in the fore wing in having the branches more of an arborescent type, in which it is difficult to say what course the main vein with its irregular or regular breaking up takes, or on which side, if not on both, the principal branches are thrown off from the main stem. In general the division of the scapular and externomedian areas on the border is at or close to the apex of the wing, which seems always to lie, not at the end of the middle line of the wing, but somewhere in its upper half, so that the wing is less symmetrical in form than the fore wing.

Whether we shall ever be able to determine the characteristics of different genera in the hind wings may be deemed doubtful; certainly not until a vast deal more is known about them than now. Possibly when the rich Blattarian fauna of Commentry has undergone the investigation it awaits at the hands of Mr. Charles Brongniart, we shall be able to speak more hopefully, but at present the genus Etoblattina is the only one of which we have representatives of more than a single species.

In Etoblattina the hind wing is pointed-ovate, broadest beyond the middle, fully twice as long as broad, with very straight costa until the wing begins to narrow, and with a very full and rounded inner border, the apex being not far from the middle of the upper half of the wing. The mediastinal area is very narrow and reaches to the middle of the apical half of the wing or farther, with arcuate, very oblique branches. The scapular vein is very straight, throws off very oblique forking branches to the costal margin, first forking a little before the middle of the wing, and terminates at or above the apex. The externomedian vein is likewise straight, first branches as soon as or a little before the scapular, the branches forked or generally compound, rarely simple, and nearly or quite longitudinal; they seem to be indifferently inferior or superior, but all either one or the other. The internomedian area is very broad, generally occupying fully half the breadth of the wing in its basal half, the main vein straight or nearly straight, running obliquely to the inner margin of the wing and ending just about as far toward the apex as the mediastinal vein; the branches are all inferior, closely crowded, nearly straight and oblique, and generally simple. Of the anal area nothing can be known from present specimens, excepting what is seen in the specimen figured on Pl. XII, figs. 6, 7, which will be mentioned in its description, later in this paper.

An exception to these characters is so great in a hind wing, which I have recently figured[1] and called an Etoblattina, that I am now inclined to think it can not belong to this genus, but perhaps to Gerablattina, also found in the same beds. It is again figured here in Pl. XII, fig. 4. These exceptions consist in the form of the wing, in which the apex (which is destroyed) apparently must fall about the middle of the wing, while the inner border is much less full; in the earlier forking of both scapular and externomedian veins, the former earlier than the latter; the more arborescent or apical branching of the externomedian vein, the branches of which are both superior and inferior, and in the different character of the internomedian area, which is by no means so broad as in all the Etoblattinæ known, and has only a few branching, very oblique veins. The anal area is here preserved, and is remarkable as being but a shorter form of the mediastinal type.

The hind wing of Archimylacris, so far as we know it, is again somewhat different. The form would appear to be the same as in Etoblattina and the mediastinal area similar but much longer. The scapular vein, however, is very different, and the few branches are distant, inferior, and include the apex at the margin, extending, indeed, farther below the apex than above it. The externomedian vein appears to be a repetition on a lesser scale of the scapular, but more can not be said.

The peculiar character of the internomedian area in Mylacris has already been mentioned. All that can be further said of the hind wing in this genus is that the externomedian vein (excepting that the branches are superior and not inferior) appears to be a repetition of the same area in the fore wing and to bear a similar relation to the internomedian area.

In Paromylacris the scapular and externomedian areas appear to be extremely similar to their condition in Etoblattina, the division line between them also falling at just about the pointed apex of the wing, which, so far as can be seen, has a similar form.

Probably the same is also true of Promylacris, though this is entirely uncertain from the slight fragment of the apex which is preserved, for, on the contrary, it may be entirely similar to the wings figured on Pl. XII, fig. 5.

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[1] Bull. U. S. Geol. Surv., No. 101, pl. 2, Fig. k.

IV. POSSIBLE MIMICRY IN PALEOZOIC COCKROACHES.

Before finishing these introductory remarks I wish to draw attention to a topic unusual in such a connection. In studying protective resemblance and mimicry among living animals, the exceedingly common occurrence of these phenomena has often forced upon me the conclusion that they have not been limited in their scope to recent times, but must have existed in past epochs and even, to some extent at least, in very remote epochs. This is a natural conclusion from the universality of their present occurrence. Hardly an animal exists that does not actually owe its existence to some feature or features in its form or coloring. This statement will doubtless appear strong to those who are unacquainted with or have not considered the facts. Let me reenforce it in the words of its latest exponent, M. Félix Plateau, the well-known professor in the University of Gand:

> The thesis I wish to sustain, in agreement with naturalists of high merit, would demonstrate that the phenomena [of mimicry] are general; that is to say, that there are hardly any animals which, in at least some one of the stages of their existence, do not have recourse to imitation; that in our own countries, in temperate Europe, in Belgium itself, the zoologist who is really an observer meets at every step cases of dissimulation which are every whit as striking as [ne le cédent en rien] those which tropical nature offers us.[1]

The arguments I have used in my own essay on the subject[2] attempt to show that in the very nature of things protective resemblance must prevail in a world where creatures are the food of others, and where they escape destruction only when less easily or less frequently seen by their predaceous foes than their fellows. From this standpoint it would be difficult to refrain from the logical conclusion that protective resemblance was nearly or quite as much a feature of past life as it is of present.

Naturally, since coloring forms the most important or the most common part of protection, proof of such protection can not be derived from the fossils. But pattern of markings is also a conspicuous element of protection in existing types, and in a few fossils among insects we can detect markings of a precisely similar nature to some which in existing insects can be proved protective; but here habit and association are often necessary factors, and these can usually only be inferred in the extinct types, but inferred in some instances with considerable reasonableness. The examples which I have in mind are all drawn from Tertiary faunas; but I refer to the matter here since it seems to me fairly reasonable to look upon some forms of Carboniferous cockroaches as probably imitative and thereby protective. The first cockroach wing ever described was first described as a fern leaf, and in all or nearly all the localities where their remains have been found they are associated with fern-leaves in immense abundance. While searching for their remains in the Permian deposits at Cassville I was much *struck* by this resemblance and was repeatedly obliged to use the glass to determine whether it was the wing of a cockroach or the frond of a fern I had uncovered, and the instances are not rare where they agree completely in size. The general distribution of the nervures is to cursory view the same in each, and the form is often nearly identical. Only the differentiation of the anal area in the cockroach wing at once distinguishes them, but this is really a feeble point and would often be noticed only by an expert. To show how close the general resemblance is I place here side by side figures of a cockroach wing and a fern frond found associated in the same beds[1] and ask whether it is not plausible to suppose that the intimacy of the resemblance is due, as such an instance of associated organisms would now be regarded if the color agreed, to the action of selection in producing protective resemblance. The ordinary color of the tegmina of existing cockroaches is brown or testaceous, yet there are not wanting numerous examples, at least in the tropics, where they are as green as the leaves of ordinary vegetation.

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[1] Bull. Acad. Roy. Belg. (3), XXIII, 92 [1892].

[2] Atlantic Monthly, Feb., 1889; Butt. east. U. S. and Canada, 710-720.

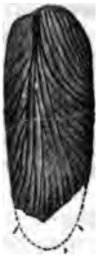

FIG 1.—*Gerablattina permanenta.*

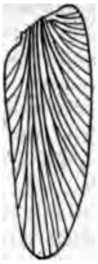

FIG. 2.—One of the pinnæ of *Neuropteris odontopteroides.*

V. THE EUROPEAN SPECIES OF ETOBLATTINA, WITH DESCRIPTION OF A NEW FORM.

For the convenience of students a first essay is here made to tabulate the European species of Etoblattina, the genus of cockroaches most numerously represented in Carboniferous times, both in Europe and America. All the species described up to the present time are introduced, together with a new British species, a description of which is added. It will be seen that Deichmüller's var. *stelzneri* (regarded by him as a form of *E. flabellata*), and Geinitz's var. *dyadica* (regarded by him as another form of the same), are considered distinct species; and that *E. rollei* Deichm. is not included, this last being more probably a Gerablattina. *E. peachii* Woodw. is also omitted, as the tegmina are undeveloped, and therefore present no features which could admit it into the table. On the other hand, *Blattina intermedia* Gold., formerly described by me as a Gerablattina, has had new light thrown upon it by Kliver, showing it to be an Etoblattina, and it is accordingly introduced here.

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[1] Specimens showing far closer resemblance could easily be selected, but the time at my disposal when the illustration was needed did not admit of a better choice. The plant is from the roof shales of the Waynesburg coal, above the "roof coal" at Cassville and [illegible], copied from one of the figures in Fontaine and White's Permian Flora (Rep. Penn. Geol. Surv., PP). The insect comes from the shales which separate the "roof coal" from the main coal beneath, at the same locality.

Table of the European species of Etoblattina.

a^1. Tegmina broad, at most but little more than twice as long as broad, the mediastinal area usually broad at base, here generally occupying a third or more of the tegmina.
b^1. Mediastinal area tapering gradually, and relatively long, more, often much more, than four times as long as greatest breadth.
c^1. Relatively slender, the tegmina distinctly more than twice as long as broad.
d^1. Apical margin divided between the scapular and externomedian areas. 1. *E. labachensis.*
d^2. Apical margin divided between the externomedian and internomedian areas .... 2. *E. intermedia.*
c^2. Tegmina broad, not more than twice as long as broad, the immediate apex occupied by the externomedian branches.
d^1. Tegmina less than twice as long as broad; mediastinal area reaching nearly to the middle of the distal half of the tegmina; externomedian vein first forking not before the middle of the tegmina .... 3. *E. propria.*
d^2. Tegmina twice as long as broad; mediastinal area hardly extending beyond the middle of the tegmina; externomedian vein first branching far before the middle of the tegmina......... 4. *E. deichmülleri.*
b^2. Mediastinal area tapering rapidly and relatively short, less, often much less, than four times as long as basal breadth.
c^1. Internomedian area long and numerously branched, falling but little short of the apex of the tegmina.
d^1. Humeral angle prominent, the tegmina less than twice as long as broad. 5. *E. steinbachensis.*
d^2. Humeral angle roundly excised, the tegmina more than twice as long as broad .... 6. *E. primæva.*
c^2. Internomedian area relatively short and with few branches, falling far short of the apex of the tegmina.
d^1. Mediastinal vein with frequent branches; scapular branches few, mostly forked deeply or compound..................... 7. *E. deanensis.*
d^2. Mediastinal vein with infrequent branches; scapular branches numerous, mostly simple or only apically forked......... 8. *E. lanceolata.*
a^2. Tegmina relatively slender, rarely less than two and a half times as long as broad, the mediastinal area usually rather slender and ribbon-shaped, not or scarcely broader at base than in the middle, and rarely occupying more than a fourth of the basal width of the tegmina.
b^1. Tegmina distinctly less than three times as long as broad.
c^1. Internomedian area long but far from attaining the apex of the tegmina, rarely prolonged by distinct sinuosity of the main vein.[1]
d^1. Mediastinal area extending well beyond the middle of the tegmina.
e^1. Externomedian vein first branching beyond the middle of the tegmina. 9. *E. carbonaria.*
e^2. Externomedian vein first branching far before the middle of the tegmina.
f^1. Tegmina of large or medium size, well rounded at apex; externomedian area expanded and on the margin as important as the scapular.
g^1. First scapular branch arising far before the succeeding, near the middle of the basal half of the tegmina; internomedian vein scarcely sinuate .... 10. *E. russoma*

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[1] This is only conjectural in *E. mantidioides*, but indicated by the parts preserved.

Table of the European species of Etoblattina—Continued.

g^2. First scapular branch arising but little before the middle of the tegmina and at ordinary distance before the succeeding; internomedian vein strongly sinuate .... 11. *E. dyadica.*

f^2. Tegmina of small size, subacuminate at apex; externomedian area compressed and on margin of much less importance than the scapular .... 12. *E. parvula.*

d^2. Mediastinal area scarcely if at all surpassing the middle of the tegmina.[1]

e^1. Scapular and externomedian veins first branching at nearly the same point.[2]

f^1. Primary offshoots of the externomedian vein numerous.

g^1. Course of the externo-internomedian interspace gently oblique, arcuate .... 13. *E. manebachensis.*

g^2. Course of the externo-internomedian interspace strongly oblique, sinuous .... 14. *E. ornatissima.*

f^2. Primary offshoots of the externomedian vein only two or three in number .... 15. *E. anthracophila.*

e^2. First branching of the externomedian vein far beyond that of the scapular .... 16. *E. mantidioides.*

c^2. Internomedian area very long, nearly reaching the apex, or reaching the apical margin, often prolonged by distinct sinuosity of the main vein.

d^1. Mediastinal area extending well beyond the middle of the tegmina.

e^1. Scapular vein first branching far beyond the middle of the tegmina. 17. *E. johnsoni.*

e^2. Scapular vein first branching before, often far before, the middle of the tegmina.

f^1. All the internomedian branches simple or simply forked.

g^1. Scapular vein first branching at some distance before the externomedian .... 18. *E. dohrnii.*

g^2. Scapular vein first branching but little before the externomedian.

h^1. Mediastinal and scapular branches with normal obliquity; internomedian branches frequent, with normal obliquity. 19. *E. didyma.*

h^2. Mediastinal and scapular branches very longitudinally oblique; internomedian branches exceedingly few and longitudinally oblique .... 20. *E. bituminosa.*

f^2. Some apical branches of the internomedian vein compound. 21. *E. anaglyptica.*

d^2. Mediastinal area hardly reaching the middle of the tegmina.

e^1. Scapular vein in the middle of its course receding from the margin to reach the middle line of the tegmina...... 22. *E. leptophlebica.*

e^2. Scapular vein in the middle of its course hardly receding from the margin and nowhere nearly reaching the middle line of the tegmina .... 23. *E. flabellata.*

b^2. Tegmina distinctly more than three times as long as broad; internomedian area long and slender.

c^1. Internomedian area not nearly reaching the apex of the tegmina, with no extension by the distal sinuosity of the main vein.

d^1. Tegmina less than 20 mm. long; course of the main scapular vein distinctly sinuous, and at one point nearly reaching the middle line of the tegmina .... 24. *E. affinis.*

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[1] This is conjectural but probable in *E. ornatissima* by the brief extent of the scapular area.

[2] Conjectural again, but probable, with *E. ornatissima.*

Table of the European species of Etoblattina—Continued.

d^2. Tegmina more than 30 mm. long; course of the main scapular vein nearly or quite straight, at no point nearly attaining the middle line of the tegmina.
  e^1. Tegmina subequal on distal half (apparently; the only specimen is broken), the externomedian vein with regular offshoots from the middle of the tegmina outward.......... 25. *E. euglyptica.*
  e^2. Tegmina tapering considerably throughout the distal half, the externomedian branches all arising close to the apex from two stems which unite at or before the middle of the tegmina.... 26. *E. elongata.*
c^2. Internomedian area nearly reaching the apex of the tegmina by the distal sinuosity of the main vein.
  d^1. Externomedian vein first forking well before the middle of the tegmina, with many branches; distal portion of anal area with numerous branches.................................. 27. *E. stelzneri.*
  d^2. Externomedian vein first forking at some distance beyond the middle of the tegmina, with few branches; distal portion of anal area with few branches........................ 28. *E. weissigensis.*

ETOBLATTINA DEANENSIS sp. nov.

Pl. XII, figs. 1, 3.

The fore wing has a very regular elongate oval form, tapering with considerable regularity beyond the middle third of the tegmina, the anal area by its fullness interfering a little with the regularity; it is a little more than two and a quarter times as long as broad; the costal margin has a very regular and moderately convex curve, while the inner margin, beyond the fuller and more convex anal area, is nearly straight; the tip is imperfect in the two specimens known. The veins originate slightly above the middle of the tegmina and at first all curve upward, but not so strongly as in *E. primæva*, to which this species is most nearly allied, so that the externomedian vein passes more nearly through the middle of the tegmina. The mediastinal vein passes in a scarcely sinuous course to somewhat beyond the middle of the front margin, emitting about half a dozen nearly straight, simple or deeply forked branches. The scapular vein is broadly and gently sinuous, extending to the apical margin a very little above the apex, begins to fork before the middle of the proximal half of the tegmina, and has four subequidistant branches, of which the first is compound, the others forked or simple. The externomedian vein first forks near the middle of the tegmina, where it divides into two very similar, weakly arborescent, longitudinal stems carrying about ten or a dozen veinlets to the apical and to the outer portion of the inner margin. The internomedian vein is very regularly and rather gently arcuate except for a slight apical sinuosity which carries it nearly to the apical sixth of the tegmina, and has about five nearly straight branches, some of the basal ones simply or doubly forked. The anal furrow is not very deeply impressed, very regularly but not very strongly arcuate, and ends at about the middle of the tegmina. The anal veins consist of two sets, rather widely separated at the base, the inner set consisting of a several-branched main stem subparallel to the anal furrow, the outer to four or five simply or doubly forked, approximated, slightly divergent nervules, more nearly longitudinal than the other set.

The two specimens known, one with its reverse, are coal black; the one with its reverse is nearly perfect, having lost only the shoulder and the apical margin; the other specimen consists of two tegmina, of one of which only the base and the anal area is preserved and which lies partially concealing the reversed face of the other, of which the basal portion and considerable of the apex is lost. Excepting in the anal and internomedian areas the veins are pronounced, being deeply incised; in the internomedian area they are very delicate. Toward the apex of the tegmina an exceedingly delicate reticulation can be detected in the interspaces, which gives way in the center of the tegmina to a very close series of dulled cross-lines, and become in the scapular area parallel to the nearer margin.

Length of the tegmina, 38 mm.; breadth, 13.25 mm.

The two specimens differ from each other in hardly anything but the simplicity or complexity of the several branches of the main veins, particularly in the upper stem of the externomedian vein and the principal branches of the internomedian vein. In one, however, the costal margin appears to be distinctly more arcuate than in the other.

The species is plainly most nearly allied to *E. primæva*, from which it differs in its more elongate form, apical tapering, the lack of an extreme basal branch of the scapular vein, the far greater importance though later branching of the externomedian vein, the narrower and shorter internomedian area and its simpler apical branching, the more regular curve of the anal furrow, the entire system of anal veins, and the lower course of all the main veins through the middle area of the tegmina.

The specimen with reverse, fig. 1, comes from Foxe's bridge, in the Forest of Dean, Gloucester, England. The other was collected by F. Stock at Crump meadow, in the Forest of Dean. Both are in the collection of Mr. R. D. Lacoe, in which they bear the number 2132 *a–b*, *c*.

VI. A LIST OF THE DESCRIBED EUROPEAN PALEOZOIC COCKROACHES.

The species in this list are arranged alphabetically under each genus, but the genera are in a natural order. Several species, because too imperfectly known, are not mentioned, as they can not be placed. Such are *Blattina ligniperda* Kušta, from Lubná, Bohemia; *B. neuropteroides* Göpp. and *B. rarinervis* Göpp., from an unnamed locality; *B. tischbeini* Gold., from Hirschbach, Germany, and *B. venosa* Gold., from Wemmetsweiler, Rhenish Prussia. *Etoblattina peachii* Woodw., from Kilmaurs, Scotland, is also omitted, as the undeveloped tegmina hardly allow it to be definitely placed.

A list of the described European Paleozoic cockroaches.

Etoblattina affinis (Gold.), Löbejün and Wettin, Saxony.
anaglyptica (Germ.), Wettin, Saxony.
bituminosa (Kušta)[1], Lubná, Bohemia.
carbonaria (Germ.), Wettin, Saxony.
deanensis Scudd., Forest of Dean, Gloucester, England.
deichmülleri (Gein.)[2], Weissig, Saxony.
didyma (Germ.), Wettin, Saxony; Manebach, Saxe-Weimar.
dohrnii Scudd., Wettin, Saxony.
dyadica (Gein.)[3], Weissig, Saxony.
elongata (Gein.), Weissig, Saxony.
euglyptica (Germ.), Wettin, Saxony.
flabellata (Germ.), Wettin and Weissig, Saxony.
intermedia (Gold.), Wemmetsweiler, Rhenish Prussia.
johnsoni Woodw., Dudley, England.
labachensis (Gold.), Labach, Rhenish Prussia.
lanceolata (Sterz.), Lugau, Saxony.
leptophlebica (Gold.), Löbejün, Saxony.
manebachensis (Gold.), Manebach, Saxe-Weimar.
mantidioides (Gold.), Durham, England.
ornatissima Deichm., Grügelborn, Rhenish Prussia.
parvula (Gold.), Löbejün, Saxony.
primæva (Gold.), Saarbrücken, Rhenish Prussia.
propria Kliver, Saarbrücken, Rhenish Prussia.
russoma (Gold.), Löbejün, Saxony.
steinbachensis Kliv., Steinbachthal, Rhenish Prussia.
stelzneri (Deichm.),[4] Weissig, Saxony.
weissigensis (Gein.), Weissig, Saxony.

Gerablattina clathrata (Heer), Manebach, Saxe-Weimar.
geinitzi (Gold.), Löbejün, Saxony.
germari (Gieb.), Wettin, Saxony.
goldenbergi (Mahr), Manebach, Saxe-Weimar.
mahri (Gold.), Manebach, Saxe-Weimar.
münsteri Scudd., Wettin, Saxony.
producta Scudd., Wettin, Saxony.
robusta Kliv., Wemmetsweiler, Rhenish Prussia.
rollei (Deichm.),[5] Grügelborn, Rhenish Prussia.
scaberata (Gold.), Altenwald, Rhenish Prussia.
weissiana (Gold.), Brücken, Rhenish Bavaria.

Anthracoblattina camerata Kliv., Dudweiler, Rhenish Prussia.
dresdensis (Gein.-Deichm.), Klein Opitz, Saxony.
incerta Kliv., Dudweiler, Rhenish Prussia.
lubnensis (Kušta),[6] Lubná, Bohemia.
porrecta (Gein.), Weissig, Saxony.
remigii (Dohrn), Cusel, Rhenish Bavaria.
rückerti (Gold.), Stockheim, Bavaria.
scudderi Gold., Wemmetsweiler, Rhenish Prussia.
sopita Scudd., Weissig, Saxony.
spectabilis (Gold.), Weissig? and Löbejün, Saxony.
wagneri Kliv., Löbejün, Saxony.
winteriana (Gold.), Dudweiler, Rhenish Prussia.

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[1] *Blattina (Etoblattina) bituminosa* Kušta.

[2] *Blattina (Etoblattina) carbonaria*, var. *deichmülleri* Gein.

[3] *Blattina (Etoblattina) flabellata*, var. *dyadica* Gein.

[4] *Etoblattina flabellata*, var. *stelzneri* Deichm.

[5] *Etoblattina rollei* Deichm.

[6] *Blattina (Anthracoblattina) lubnensis*, Kušta.

A list of the described Paleozoic cockroaches—Continued.

Hermatoblattina kirkbyi (Woodw.), Fifeshire, Scotland.
lebachensis (Gold.), Lebach, Rhenish Prussia.
wemmetsweileriensis (Gold.), Wemmetsweiler, Rhenish Prussia.
Progonoblattina fritschii (Heer), Manebach, Saxe-Weimar.
helvetica (Heer), Erbignon, Switzerland.
Oryctoblattina arndti Kušta, Třemošná, Bohemia.
oblonga Deichm., Weissig, Saxony.
reticulata (Germ.), Wettin, Saxony.
Petrablattina gracilis (Gold.), Lebach, Rhenish Prussia.
Leptoblattina exilis Woodw., Dudley, England.
insignis (Gold.), Dudweiler, Rhenish Prussia.

VII. THE TERMINOLOGY OF THE NEURATION.

In explanation of the terminology here used for the neuration of the tegmina and wings of Paleozoic cockroaches, and in which I have simply followed Heer, the accompanying figure of one of the tegmina of *Etoblattina mazona* from the Carboniferous beds of Illinois is introduced, enlarged two diameters, with the veins at the base of the tegmina named, and the areas marked along the margin. These names are employed in all the descriptions.

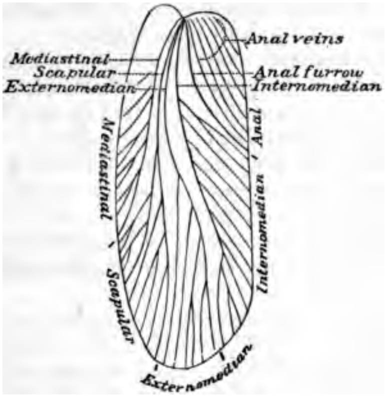

FIG 3.—*Etoblattina mazona*, with the nomenclature of the parts.

TABLE OF THE GENERA OF AMERICAN FOSSIL COCKROACHES.

This table is also applicable to the European genera, for one Paleozoic genus not yet found in America is included in it, distinguished by an asterisk following it. Leptoblattina, exclusively European, is not included, as the neuration of the tegmina is too obscure to place it.

A.^{1} **All six** of the main veins of tegmina independent (excepting sometimes in the basal fourth of the tegmina); anal veins impinging on the hind margin .... PALÆOBLATTARIÆ.

B^1 **Branches of** the mediastinal vein arranged in a radiate manner, mostly springing from a common point at the base of the tegmina; mediastinal area subtriangular, uniformly tapering apically.... MYLACRIDÆ.

Table of the genera of American fossil cockroaches—Continued.

c^1. All or very nearly all the branches of the mediastinal vein arising close to the base of the tegmina.
  d^1. Mediastinal and scapular areas together occupying less than half the tegmina.
    e^1. Scapular area larger than the mediastinal .... 1. ***Mylacris.***
    e^2. Scapular area smaller than the mediastinal .... 2. ***Promylacris.***
  d^2. Mediastinal and scapular areas together occupying half or more than half the tegmina.
    e^1. Tegmina narrow; externomedian area small and compressed, scarcely expanding apically .... 3. ***Lithomylacris.***
    e^2. Tegmina broad; externomedian area expanding apically 4. ***Paromylacris.***
c^2. A number of the apical branches of the mediastinal vein arising beyond the base of the tegmina, and scarcely partaking of the radiate arrangement of the others .... 5. ***Necymylacris.***
B^2. Branches of the mediastinal vein arising at regular intervals from a principal stem; mediastinal area generally band-shaped.... BLATTINARIÆ.
c^1. Internomedian vein long, terminating beyond, rarely at, the middle of the outer half of the tegmina; scapular and externomedian areas together generally covering less than one half of the tegmina.
  d^1. Mediastinal area comparatively short, rarely exceeding, seldom equaling, two-thirds the length of the tegmina.
    e^1. Externomedian branches inferior, so that the nervules divaricate on either side of the scapular-externomedian interspace .. 6. ***Microblattina.***
    e^2. Externomedian branches superior, so that the nervules divaricate on either side of the externomedian-internomedian interspace.
      f^1. Scapular area extending beyond and embracing the extreme tip of the tegmina by the backward sweep of the main vein; externomedian area comparatively small .... 7. ***Archimylacris.***
      f^2. Scapular area not reaching tip of tegmina, the extremity of the main vein curving only upward; externomedian area comparatively large.
        g^1. Externomedian and internomedian veins sinuous, distinctly diverging around a median stigma .... 8. ***Spiloblattina.***
        g^2. Externomedian and internomedian veins nearly straight, with little or no median repulsion .... 9. ***Etoblattina.***
  d^2. Mediastinal area long, usually at least three-fourths the length of the tegmina, sometimes nearly reaching the tip.
    e^1. Branches of scapular vein superior.
      f^1. Externomedian branches superior, so that the nervules divaricate on either side of the externomedian-internomedian interspace. 10. ***Gerablattina.***
      f^2. Externomedian branches inferior, so that the nervules divaricate on either side of the scapular-externomedian interspace. 11. ***Anthracoblattina.***
    e^2. Branches of scapular vein inferior .... 12. ***Hermatoblattina.****
c^2. Internomedian vein short, terminating before the middle of the outer half of the tegmina; scapular and externomedian areas together generally covering more than half the tegmina.
  d^1. Branches of externomedian vein inferior.
    e^1. Principal veins closely crowded in the basal half of the tegmina; branches uniformly distributed all over the wing; scapular area terminating above the apex of the tegmina........... 13. ***Progonoblattina.***

Table of the genera of American fossil cockroaches—Continued.

e^3. Principal veins widely separated in the basal half of the tegmina; branches much more closely crowded in some parts of the tegmina than in others; scapular area terminating below the apex of the tegmina.................................... 14. *Oryctoblattina.*

d^2. Some or all of the branches of externomedian vein superior.

e^1. Externomedian vein directed toward the distal half of inner border of tegmina; internomedian vein moderately long.. 15. *Poroblattina.*

e^2. Externomedian vein directed toward and terminating at or but little beyond the middle of the inner border of tegmina; internomedian vein very short.................................. 16. *Petrablattina.*

A^2. Two or more of the six principal veins of tegmina amalgamated through the whole or the greater part of their length; most of the anal veins impinging on the anal furrow or forming a fusiform bunch directed toward the tip of the furrow....... NEOBLATTARIÆ.

B^1. Surface of tegmina distinctly divided into four fields, each occupied by a principal vein (Mesozoic genera).

c^1. Tegmina diaphanous, rounded at tip, not strongly vaulted; anterior main vein sinuous, falling short of apex........... 17. *Neorthroblattina.*

c^2. Tegmina coriaceous, more or less pointed at tip, strongly vaulted at base; anterior main vein straight, terminating at or below the apex. 18. *Scutinoblattina.*

B^2. Surface of tegmina not distinctly divided into four fields, but either into three or the neuration greatly confused by adventitious folds (Cenozoic genera).

c^1. Fore wings without a longitudinal fold; neuration normal.

d^1. Internomedian branches mostly arising from a dichotomous division of two main stems.. 19. *Zetobora.*

d^2. Internomedian branches mostly arising as simple inferior branches of two main stems.................................. 20. *Homoeogamia.*

c^2. Fore wings with a longitudinal fold, interfering with the neuration. 21. *Paralatindia.*

PALÆOBLATTARIÆ.

The geological range of this ancient type of cockroaches was formerly supposed to be limited to Paleozoic time and specifically to Carboniferous and Permian rocks; but it has since been shown that it occurs in some numbers in the Trias of Colorado, which now forms its upper limit; inferiorly it has been found scantily in the Millstone Grit, but there can be little doubt that its actual appearance on the earth was at a much earlier epoch.[1]

Although our knowledge has been vastly extended within the past fifteen years and the number of known species has been multiplied nearly fourfold, principally from additions in this country, the number of genera has increased by only about two-thirds, and the number of primary groups remains the same. We are now acquainted with sixteen genera and about two hundred species, by far the larger part of which belong to one of the two principal divisions, the Blattinariæ.

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[1] *Palæoblattina douvillei* Brongn., from the lower part of the Upper Silurian of Jurques, Calvados, France, regarded by Brongniart as a cockroach, appears to me from his figures to belong to the neuropteroid series, and therefore it is not considered here.

MYLACRIDÆ.

This group of Palæoblattariæ, with a single exception (*Promylacris harei*), found in the Barren Coal-measures, is confined to the true Productive Coal-measures, and, as far as definitely known, to American deposits. Brongniart, as pointed out above (p. 21), states that Mylacridæ are common in the Coal-measures of Commentry, in France, and there is no reason to doubt his statement, but the proof of it has not yet been published. Considering that they are unknown in Permian or later rocks, and seem to represent an older type than the Blattinariæ,[1] it is a little surprising that they have not as yet, like several genera of Blattinariæ, been detected in the Millstone Grit. Their known geologic range is therefore considerably more confined than that of the Blattinariæ, which extend from the Millstone Grit to the Trias. Five genera and twenty-nine species have so far been detected, with indications of others. By far the majority occur in the older true Productive Coal-measures, and below the Barren Coal-measures they are nearly as abundant in species as the Blattinariæ, though representing fewer genera.

1. Genus MYLACRIS.

Mylacris Scudd., Worth., Geol. Surv. Ill., III, 568–569.

This genus is confined, so far as known, to North America, and is the richest of the Mylacridæ in species, fourteen in number, being thus in fact nearly as rich as all the other genera of Mylacridæ combined. It has been found in four different coal basins—the Acadian, the Rhode Island, the Pennsylvania, and the Eastern Interior, in the last two of which it is richest in species. As far as known, it is mostly confined to the Lowest Productive Coal-measures, though one of the two species of the anthracite fields of Pennsylvania (near the base of the division), *M. carbonum*, is common to them and the Lower Productive Coal-measures, and affords almost the only instance where one of our Carboniferous species has been found, even in two separate localities.

Table of the species of Mylacris.

a^1. Mediastinal area slender, especially at base.
  b^1. Scapular nervules longitudinal, very long, and not numerous.. 1. ***M. packardii.***
  b^2. Scapular nervules oblique, numerous, and not very long.... 2. ***M. bretonensis.***
a^2. Mediastinal area broad, especially at base.
  b^1. Externomedian nervules superior or apical.
    c^1. Externomedian nervules distinctly superior.
      d^1. Costal margin considerably arcuate on the basal third of the tegmina, so that the humeral shoulder is well rounded.
        e^1. Tegmina almost or quite two and a half times longer than broad. 3. ***M. elongata.***
        e^2. Tegmina hardly if any more than twice as long as broad.
          f^1. Mediastinal area reaching only to the end of the middle third of the tegmina; internomedian vein with numerous closely crowded branches. 4. ***M. anthracophila.***

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[1] See my Paleozoic Cockroaches. Mem. Bost. Soc. Nat. Hist., III, 31, 32; **Foss. Ins. N. A., I, 51–51.**

Table of the species of Mylacris—Continued.

f^2. Mediastinal area reaching well into the distal third of the tegmina; internomedian vein with few and rather distant branches. 5. *M. gurleyi.*
d^2. Costal margin very slightly arcuate on the basal third of the tegmina, so that the humeral shoulder is very pronounced.
  e^1. Scapular area much less important than the externomedian, the tegmina rapidly narrowing in the apical half.................. 6. *M. ampla.*
  e^2. Scapular area much more important than the externomedian, the tegmina much less rapidly narrowing apically.... 7. *M. priscovolans.*
c^2. Externomedian nervules rather apical than superior.
  d^1. Externomedian area occupying the apex of the tegmina..... 8. *M. heeri.*
  d^2. Externomedian area falling wholly below the middle line of the tegmina.
    e^1. Mediastinal nervules comparatively few and distant; scapular vein forked at base.................................... 9. *M. antiqua.*
    e^2. Mediastinal nervules numerous; scapular branches all emitted from a single main branch............................ 10. *M. lucifuga.*
b^1. Externomedian nervules inferior.
  c^1. Costal much more curved than inner margin.
    d^1. Costal margin very strongly curved in the mediastinal area, which scarcely reaches to the middle of the tegmina..............11. *M. carbonum.*
    d^2. Costal margin gently curved in the mediastinal area, which extends considerably beyond the middle of the tegmina.. 12. *M. pennsylvanica.*
  c^2. Costal and inner margins similarly and symmetrically curved.
    d^1. Combined mediastinal and scapular areas as broad at the base as beyond. 13. *M. mansfieldii.*
    d^2. Combined mediastinal and scapular areas much broader near the middle of the tegmina than at the base.................. 14. *M. ovalis.*

1. MYLACRIS PACKARDII.

Pl. I, figs. 2, 3.

Mylacris packardii Scudd., Bull. U. S. Geol. Surv. No. 101, pp. 11–12, pl. 1, figs. *e. g.* (1893).

From the Lowest (?) Productive Coal-measures at Bristol, R. I.

2. MYLACRIS BRETONENSIS.

Blattina bretonensis Scudd., Can. Nat., VII, 271–272, fig. 1 (1874).
Mylacris bretonensis Scudd., Mem. Bost. Soc. Nat. Hist., III, 41–42, 300, pl. 5, fig. 1 (1879); Foss. Ins. N. A., I, 61–62, 264, pl. 5, fig. 1 (1890).

From the Productive Coal-measures of Sydney, Cape Breton.

3. MYLACRIS ELONGATA sp. nov.

Pl. I, fig. 6.

The tegmina are unusually slender for a Mylacris, the specimen at hand, though incomplete at both extremities, being certainly two and a half times longer than broad; it is subequal in width on the basal half, but on the apical half narrows somewhat rapidly by the stronger arcuation of the costal margin, the inner margin being almost straight except at the extreme base and perhaps the tip; the extreme apex is broken. The veins originate below the middle of the base and curve somewhat strongly upward before assuming their final direction, which for most of them is subparallel to the outer margin obliquely inward toward the tip. The mediastinal area is rather narrow for a Mylacris, and more than usually elongated, tapering more gradually than usual, and reaching almost or quite to the end of the middle third of the wing; most of the nervules are simple throughout. The main scapular vein begins to branch by or before the middle of the basal half of the wing, and while branching is almost exactly straight and subparallel to the outer margin, coursing through the middle of the wing, but just before emitting its last branch it is gently arcuate and assumes a course parallel to the inner margin; it sends off six branches parallel to the mediastinal branches, all simple except one, which is very deeply forked. The externomedian vein runs parallel to the scapular until it branches just before the middle of the wing, and then bends slightly downward and terminates on the inner margin, throwing off four principal nervules, the first of which is doubly forked. The internomedian vein is gently sinuate and parallel to the externomedian throughout its course, terminating on the inner margin shortly before the tip; its branches are mostly simple, but may be doubly forked, and are strongly oblique and arcuate, with their convexities toward the tip of the anal furrow. Anal area reaching nearly to the middle of the wing, strongly tumid; the anal furrow strongly arcuate but nearly straight in its apical third; the anal veins consist of two sets, one occupying almost the entire half of that portion lying next the anal furrow, consisting of a main vein with two branches, one of them forked all with a gentle arcuation in the same sense as the anal furrow; th other consisting of a crowd[1] of parallel, strongly oblique, and simple o simply forked veins gently oblique in a sense opposite to that of th anal furrow, and occupying the inner basal half.

Length of fragment, 34 mm.; probable length of tegmina, 36 mm width, 15 mm.

This clearly marked species resembles most closely *M. anthracophil* from the same beds. The general relation of all the principal vein is almost precisely the same, but it is distinctly separated from tha species by its form, which is much more slender than in *M: anthracophila* and thus gives to the mediastinal area in particular quite different form.

A single specimen and its reverse were found in the Lowest Pr ductive Coal-measures at Mazon Creek by Mr. J. C. Carr, and are no in the collection of Mr. R. D. Lacoe, of Pittston, Pa., and bear in h collection the number 2014 *a–b*.

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[1] Only a few of them have been represented by the artist; they occupy the entire inner ba portion of the area.

4. MYLACRIS ANTHRACOPHILA.

Pl. 1, figs. 1, 4.

Mylacris anthracophila Scudd., Worth., Geol. Surv. Ill., III, 568–570, figs. 5, 6 (1868); Mem. Bost. Soc. Nat. Hist., III, 45–47, pl. 5, figs. 6–8 (1879); Foss. Ins. N. A., I, 65–67, 271, pl. 5, figs. 6–8 (1890).

From the Lowest Productive Coal-measures at Colchester, Ill.

5. MYLACRIS GURLEYI sp. nov.

Pl. I, fig. 5.

The single specimen preserved in a nodule represents two tegmina and a portion of one of the under wings in a nearly natural position, but as if embracing a solid substance next the under surface, so as to present a strongly convex appearance, the cross section forming indeed almost exactly a semicircle, as seen in the line above indicating it. Neither of the tegmina is preserved entire, the tip of both, but no great portion, being lost, showing that the form of the tegmina was subtriangular, very broad at base but tapering rapidly and equably beyond to an apparently narrowly rounded apex, the form thus not differing in any essential respect from that of *M. anthracophila.* The whole wing is slightly more than twice as long as broad. The mediastinal area varies in the two wings, in the right terminating just at the end of the fragment at about the middle of the apical fourth of the wing, but in the left wing at the beginning of the apical fourth; the area is filled with a large number of simple or forked, usually apically forked, more or less arcuate, slightly diverging branches, subequidistant throughout the entire area. The scapular vein runs nearly parallel to the costal margin, but is much straighter than it, and terminates on the right at the extreme apex of the wing, on the left wing at a slight distance before it; on the right wing it does not branch until beyond the apical third, and in fact has but a single branch, which is deeply forked, the three veins running in an almost straight longitudinal course to the upper apex of the wing; in the left wing, however, it has four simple or rather deeply forked branches, the vein beginning to branch near the extreme base of the wing, and the branches thrown off at equal distances along the vein; on the right wing, therefore, the interspace between the scapular and the externomedian vein runs almost exactly through the middle of the wing; it does so also on the left wing through the basal half of the same, but thereafter curves very slightly upward so as to terminate, as before remarked, above the tip. The externomedian vein is similarly different in the two wings; on the right wing it has an arcuate course and terminates on the inner margin at a considerable distance short of the end of the mediastinal area, and emits but three straight, longitudinal branches, the first beyond the middle of the wing; on the left wing it is much straighter and terminates on the inner margin a long distance beyond the apex of the mediastinal area, and has but two branches, the first of which, arising but shortly beyond the basal third of the wing, is compound, while the second arises at the beginning of the apical third of the wing, the area occupying the apex of the wing, more, however, upon its inner than its costal side. The internomedian vein runs exactly parallel to the externomedian and is therefore more curved on the right than on the left wing, and has three or four simple or deeply-forked branches which arise at equal distances on the left wing but at very unequal distances on the right. The anal furrow is deeply impressed, but its apical portion is lost in both wings; it appears, however, to terminate beyond the basal third of the wing and to be strongly arcuate at the base, beyond nearly straight; the anal area is filled with a number of mostly simple branches, but on the right wing many of them originate at equal distances apart from the vein which runs subparallel and next to the anal furrow, while on the left wing it is one of the middle veins which is compound.

A broken portion of one of the hind wings is preserved, that of the right side, which seems to show that the externomedian and internomedian veins were somewhat similar to those of the fore wing, but that they had a straight, longitudinal course instead of being strongly arcurate, as in the fore wing, and the internomedian branches arise at equal distances apart.

This insect appears at first sight to show a greater difference between the neuration of the two fore wings than any other species which has yet been described, but in reality the difference is almost entirely made up by the greater extent of the mediastinal area on the right wing and the consequent pushing of all the succeeding areas farther along to the final reduction of the internomedian area. It, and especially the left wing, resembles very closely *M. anthracophila* from the same region, but differs from it markedly in the much slighter importance of the externomedian vein, although the space occupied upon the margin by this area is scarcely less. Nevertheless, on account of the difference in venation of the two wings, I had a brief hesitation to recognize it as distinct from *M. anthracophila*, but until further remains are obtained it seems wiser so to regard it. Indeed, the range of variation in the species of ancient cockroaches is a question which, even with our present greatly extended knowledge of them, it is difficult to decide, and we must still await a larger amount of material before we can come to any safe conclusion.

Length of longest fragment of tegmina, 25 mm.; probable length o tegmina, 27 mm.; breadth, 13 mm.

A single specimen from the Lowest Productive Coal-measures a Mazon Creek, Illinois, showing obverse and reverse, was obtained b Mr. W. F. E. Gurley.

6. MYLACRIS AMPLA sp. nov.

Pl. II, fig. 1.

Two well-preserved tegmina lying nearly in place, but a little separated from each other by crushing, represent this species, besides which a few segments of the abdomen are perceptible. The tegmina are unusually broad and are pretty well preserved, only the apical portion of one and the apical outer marginal portion of the other being lost at the edge of the stone. The humeral shoulder is particularly well marked, almost exactly rectangulate, with the extreme angle rounded, while the outer margin, at least in its basal half, is gently emarginate and slightly recurved. The wing is somewhat less than twice as long as broad, with the inner margin apparently nearly straight, perhaps very gently convex; the outer margin gently convex in the basal half, rather strongly convex on the apical half, so that the wing narrows rapidly behind; the form of the tip, however, can not be determined. The main veins originate at about the middle of the base of the wing, and are gently arcuate or sinuate throughout most of their course. The relative importance of the different areas appears to vary distinctly in the two wings, and the mediastinal area is of grand importance, partly on account of its great lateral expanse at the base, partly from its long extension along the outer margin, for, on the complete right wing, where it appears to be more highly developed, it extends to beyond the middle of the apical half of the outer margin and is filled with radiating veins, many of them forked and apparently formed mainly of two clusters, an outer and basal, in which the forks originate near the middle of their course, and an inner, where they are variable. The mediastinal vein takes a sinuate course, and with the externomedian appears to be more variable than any of the others; together they occupy the apex of the wing, and apparently, to judge from one wing, may unite near the middle of the basal half of the wing and form one basal stem, or they may be entirely independent, one of the other, as in the opposite wing. In the former case, as is seen in the right wing in the drawing on the plate, the scapular vein is of small importance, having but three branches, one of them once forked near the tip and terminating somewhat before the tip of the wing, while the externomedian vein occupies the entire tip of the wing, terminating on the inner border opposite the extremity of the mediastinal area and filling the space with three or four compound or forked branches. On the left wing, however, the scapular vein is of decidedly greater importance, having at least four branches, the first of them compound, and it must terminate much nearer the apex of the wing (here broken) than can be the case upon the opposite side; while the externomedian, entirely independent from its very origin, divides into two branches at no great distance before the middle of the wing, each of which branches, and especially the lower, is compound; having a general effect similar to that of the same vein on the opposite wing, but with more crowded neuration. The internomedian vein i obscure upon the right wing but clearly marked upon the left; its termination, however, is plainly similar in both; on the left wing it is seen t have four principal branches, of which the second, at least, is forked while the other appears to be simple; its course is gently sinuate, having beyond its arcuation in the basal half a distinctly more longitudinal trend. The anal furrow is rather strongly and pretty uniformly arcuate and terminates very shortly before the middle of the wing; the anal area, which is rather strongly vaulted, is filled with a series of eight or ten veins, gently arcuate in the same sense as the furrow and either simple or united to one another close to their base. Little more can be said of the abdominal segments than that they are rather short and broad and appear to be perfectly smooth, showing no structure whatever.

Length of the longest fragment of the tegmina, 30 mm.; probable length of tegmina, 33 mm.; breadth, 17 to 18 mm.; breadth of the two tegmina as they lie upon the stone, 35 mm.; length of abdominal segments, 2 mm.

This species is more nearly related to *M. priscovolans* than to an other, but is remarkable for its extreme breadth, being much broade in proportion to its length than even in that species, but showing somewhat similar length of the mediastinal area and distribution o the branches of the nervules therein. It differs in the much earlie origin of the branching of the externomedian vein and in gener resembles *M. priscovolans* more by its left wing than by its right. Th branch of the anal area is very different, as also the form of the win

The single specimen and its reverse, remarkably well preserved to texture and of a fusco-castaneous color, are embedded in a nodu from the Lowest Productive Coal-measures, at Mazon Creek, Illinois, the collection of Mr. R. D. Lacoe, where they bear the number 2021 *a*–

7. MYLACRIS PRISCOVOLANS.

Mylacris priscovolans Scudd., Mem. Bost. Soc. Nat. Hist., III, 307–308, pl. 27, fig (1884); Foss. Ins. N. A., I, 271–272, pl. 13, fig. 9 (1890).

From the bituminous coal shale of the Lowest Productive Coal-mea ures of Cannelton, Pa.

8. MYLACRIS HEERI.

Blattina heeri Scudd., Can Nat., VII, 272, fig. 2 (1874).
Mylacris heeri Scudd., Mem. Bost. Soc. Nat. Hist., III, 43–44, pl. 5, fig. 11 (1879); Fo Ins. N. A., I, 63–64, 264, pl. 5, fig. 11 (1890).

Productive Coal-measures of Sydney, Cape Breton.

9. MYLACRIS ANTIQUA.

Pl. II, figs. 5, 6.

Mylacris antiqua Scudd., Mem. Bost. Soc. Nat. Hist., III, 300–301 (1884); Foss. Ins. A., I, 264–265 (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinoi

10. MYLACRIS LUCIFUGA.

Mylacris lucifuga Scudd., Mem. Bost. Soc. Nat. Hist., III, 301-302, pl. 27, fig. 8 (1884); Foss. Ins. N. A., I, 265-266, pl. 13, fig. 8 (1890).

From the roof shales of the E seam of coal at the Port Griffith switchback, near Pittston, Pa.

11. MYLACRIS CARBONUM.

Mylacris carbonum Scudd., Mem. Bost. Soc. Nat. Hist., III, 304-307, pl. 27, figs. 6, 7, 10 (1884); Foss. Ins. N. A., I, 268-271, pl. 13, figs. 6, 7, 10 (1890).

This is the only species of Paleozoic cockroach (with the possible exception of *Etoblattina balteata*) yet found in America at two distinct horizons, one of them being in the bituminous coal shale of the Lowest Productive Coal-measures of Pennsylvania, at Cannelton, the other in the higher series at the horizon of the E vein in the Empire mine at Wilkesbarre, in the same State. Some differences appear in the specimens from the two localities, and it is possible that when complete specimens are found it may be necessary to separate the older and younger forms.

12. MYLACRIS PENNSYLVANICA.

Mylacris pennsylvanica Scudd., Mem. Bost. Soc. Nat. Hist., III, 44-45, pl. 5, figs. 13, 14 (1879); ibid., III, 302-304, pl. 27, fig. 11 (1884); Foss. Ins. N. A., I, 64-65, 266-268, pl. 5, figs. 13, 14, pl. 13, fig. 11 (1890).

From the bituminous coal shales of the Lowest Productive Coal-measures at Cannelton, Pa.

13. MYLACRIS MANSFIELDI.

Mylacris mansfieldi Scudd., Mem. Bost. Soc. Nat. Hist., III, 47, pl. 5, fig. 15 (1879); ibid., IV, 377-378 (1890); Foss. Ins. N. A., I, 67, 272, 401-402, pl. 5, fig. 15 (1890).

From the same as the preceding.

14. MYLACRIS OVALIS.

Mylacris ovalis Scudd., Mem. Bost. Soc. Nat. Hist., III, 308-309, pl. 27, fig. 5 (1884); Foss. Ins. N. A., I, 272-273, pl. 13, fig. 5 (1890).

From the same as the last two.

2. Genus PROMYLACRIS.

Promylacris Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 34 (1885).

This genus, of which four species are known, has apparently a wider range than any of the other genera of Mylacridæ, having been found not only in the Lowest Productive Coal-measures in the Eastern Interior basin, where three species occur, but also, in a single instance, in the Barren Coal-measures of the Western Interior basin.

Table of the species of Promylacris.

a^1. Prothorax distinctly twice as broad as long. Scapular vein much more important than the externomedian.

  b^1. Most of the scapular branches arising at regular intervals from the main stem. 1. *P. harei.*

  b^2. About half the scapular branches clustered as offshoots of its basal branch. 2. *P. testudo.*

a^2. Prothorax distinctly less than twice as broad as long. Scapular vein not more important than the externomedian.

  b^1. Prothorax more than half as broad again as long. Scapular vein far less important than the externomedian; anal veins simple............ 3. *P. ovalis.*

  b^2. Prothorax less than half as broad again as long. Scapular vein not far less important than the externomedian; anal veins mostly forked..... 4. *P. rigida.*

1. PROMYLACRIS HAREI sp. nov.

Pl. II, fig. 3.

A single fore wing from which the anal area is lost and in which the details of the internomedian area are also lost; it is of a regular oval form, except for the straightness of the inner margin, the costal margin being strongly arcuate throughout and the tip broadly rounded; the whole wing is slightly more than twice as long as broad. The mediastinal area terminates at the middle of the costal margin and is filled at least in its outer two-thirds with radiating, straight, forked, rather closely crowded branches, of which some eight or ten reach the margin at equal distances apart. The scapular vein is strongly sinuous and in the basal half of the wing subparallel to the costal margin, terminating just above the extreme apex of the wing; it has half a dozen subequidistant branches, most of them deeply, sometimes doubly forked, the first arising far toward the base and not diverging from the main stem for some distance and then separating into three branches, the outermost apically forked; these branches are nearly straight, less crowded than those of the mediastinal area, oblique, the apical ones longitudinal. The externomedian vein runs parallel to the scapular and does not branch until beyond the middle of the wing, when it throws off three longitudinal branches to the outer margin, the uppermost deeply forked. The course of the internomedian vein and its branches can not certainly be determined, but it terminates shortly before the apex of the wing and has on the margin numerous oblique branches, apparently similar in all respects to those of the scapular area. The anal furrow is slightly impressed, in its apical portion nearly straight, and terminates exactly at the middle of the wing.

In the form of the wing, which is less tapering than usual, this species seems to be most nearly allied to *P. testudo*, but differs considerably from it in the character of its scapular branches.

Length, 17.5 mm.; breadth, 8.5 mm.

This interesting specimen, the only species of Mylacridæ known from above the Productive Coal-measures, was found by Mr. Sidney J. Hare, a most enthusiastic searcher and student in natural history, about 170 feet above the base of the Upper Barren Coal-measures at Kansas City, Mo., and is named after him at the suggestion of Mr. R. D. Lacoe, in whose collection it bears the number 2087*a*.

2. PROMYLACRIS TESTUDO.

Pl. II, fig. 2.

Promylacris testudo Scudd., Mem. Bost. Soc. Nat. Hist., IV, 403, pl. 32, fig. 6 (1890); Foss. Ins. N. A., I, 379, pl. 24, fig. 6 (1890).

Through the kindness of Mr. R. D. Lacoe, I have had the opportunity of examining a second specimen of this species. It is somewhat smaller than the first, but has the same vaulted form, and in each case the figure represents the convex surface and not the concave cast. The first thing that will be noticed is that there is a similar difference in the venation of the opposite tegmina, only that the difference is reversed, the simpler form of branching of the scapular vein being seen on the left side in one specimen, on the right side in the other. The drawing of the mediastinal vein of the left wing in the present specimen is slightly incorrect in that the forking of the branches has been overlooked, it differing but little from that of the opposite wing. The costal margin is scarcely so convex as in the type; the mediastinal area is a little longer, terminating a little beyond the tip of the anal furrow. On each wing the branches of the scapular vein are divided into two sets just beyond the middle of the basal half of the wing, but on the left side, from the less numerous branches, the vein is less complicated than on the right, where the outer of the two at once forks into two sets of three or four branches each, and the inner divides farther out in very regular fashion into two ultimately forked branches, giving in all eleven veinlets to the margin; on the left side the outer divides into three superior branches, the inner, at first into two, the outer of which is simple, the inner of which sends from before its middle a forked superior branch, in all only seven veinlets at the margin. In the type, on the more complicated left side, by the apical forking of nearly all the branches, no less than eighteen veinlets are found upon the margin; the right side, being broken at the margin, the number of apical veinlets can not be determined, but it is probably from ten to thirteen. The externomedian vein differs from the type mainly in its later initial forking, which is decidedly beyond that of the scapular vein and but little before the tip of the anal furrow. The internomedian area is larger on the left than on the right wing, but does not differ essentially from the same area in the type. The anal furrow is entirely similar to that of the type (which is wrongly stated in the original description to terminate "a little beyond," instead of a little before, the middle of the wing), and as there the anal area is strongly vaulted, but its veins are less numerous, and one at least is deeply forked.

Length of the fragment, 13 mm.; probable length of tegmin 15 mm.; breadth of closed tegmina, 12.5 mm.

The specimen is numbered in Mr. Lacoe's collection 2089*a*, and, li the original, comes from the Lowest Productive Coal-measures at Maz Creek, Illinois.

3. PROMYLACRIS OVALIS.

Promylacris ovalis Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 34–35 (1885); Me Bost. Soc. Nat. Hist., IV, 403, 404, pl. 31, figs. 1–4 (1890); Foss. Ins. N. A., I, 3 380, pl. 23, figs. 1–4 (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinoi

4. PROMYLACRIS RIGIDA.

Pl. III, fig. 1.

Promylacris rigida Scudd., Mem. Bost. Soc. Nat. Hist., IV, 403, 404–405, pl. 31, fig (1890); Foss. Ins. N. A., I, 379, 380–381, pl. 23, fig. 6 (1890).

From the Lowest Productive Coal-measures at Braidwood, Ill.

3. Genus LITHOMYLACRIS.

Lithomylacris Scudd., Mem. Bost. Soc. Nat. Hist., III, 48 (1879); Foss. Ins. N. A., I, (1890).

This is the only genus of Mylacridæ which has been found m abundantly in the Younger than in the Older Productive Co measures, three out of the four species being confined to them in t Pennsylvania rocks, while the remaining species is found low down the Older Productive Coal-measures in the Eastern Interior basin Mazon Creek, Illinois.

Table of the species of Lithomylacris.

a^1. Externomedian vein first forking at or before the middle of the tegmina.
  b^1. Tegmina slender, fully three times as long as broad.
    c^1. Nervules numerous and very crowded; scapular branches often forked. 1. *L. angu*
    c^2. Nervules less numerous and neuration more open; scapular branches alw simple .... 2. *L. pittstonia*
  b^2. Tegmina relatively stout, being but little more than twice as broad as long 3. *L. pauper*
a^2. Externomedian vein first forking well beyond the middle of the tegmina. 4. *L. simp*

1. LITHOMYLACRIS ANGUSTA.

Lithomylacris angusta Scudd., Mem. Bost. Soc. Nat. Hist., III, 48–50, pl. 5, figs. (1879); Foss. Ins. N. A., I, 68–70, pl. 5, figs. 2, 3 (1890).

From the roof shales of the E seam of coal at the Port Griffith swit back, near Pittston, Pa.

2. LITHOMYLACRIS PITTSTONIANA.

Lithomylacris pittstoniana Scudd., Mem. Bost. Soc. Nat. Hist., III, 50–51, pl. 5, fi 4, 10 (1879); Foss. Ins. N. A., I, 70–71, pl. 5, figs. 4, 10 (1890).

From the same locality and horizon as the preceding.

3. LITHOMYLACRIS PAUPERATA.

Lithomylacris pauperata Scudd., Mem. Bost. Soc. Nat. Hist., IV, 409–410, pl. 32, fig. 5 (1890); Foss. Ins. N. A., I, 385–386, pl. 24, fig. 5 (1890).

From the same locality and horizon as the last two.

4. LITHOMYLACRIS SIMPLEX.

Lithomylacris simplex Scudd., Mem. Bost. Soc. Nat. Hist., III, 51–52, pl. 5, fig. 5 (1879); Foss. Ins. N. A., I, 71–72, pl. 5, fig. 5 (1890).

From the Lowest Productive Coal-measures at Danville, Ill.

4. Genus PAROMYLACRIS.

Paromylacris Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 35 (1885).

This genus, containing five known species, is confined to the Productive Coal-measures and almost entirely to its lowest members, only one species occurring near Pittston, Pa., near the base of the upper of the two divisions into which I have tentatively divided the Productive Coal-measures. One of the others occurs in the Western Interior coal basin, within 50 feet of the base of the true Coal-measures, the others in the Eastern Interior basin in the Mazon Creek beds, Illinois.

Table of the species of Paromylacris.

- a^1. Tegmina broadly and pretty regularly obovate, the apical not much less than the basal breadth.
  - b^1. Prothorax much more than twice as broad as long; anal furrow terminating at or before the middle of the tegmina .... 1. *P. rotunda.*
  - b^2. Prothorax much less than twice as broad as long; anal furrow terminating well beyond the middle of the tegmina .... 2. *P. ampla.*
- a^2. Tegmina tapering strongly, the apical much less than the basal breadth.
  - b^1. Mediastinal area reaching well beyond the middle of the tegmina; externomedian veins very strongly arcuate .... 3. *P. triangularis.*
  - b^2. Mediastinal area not reaching the middle of the tegmina; externomedian veins very gently arcuate .... 4. *P. clintoniana.*

P. pluteus is not included in this table.

1. PAROMYLACRIS ROTUNDA.

Paromylacris rotunda Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 35 (1885); Mem. Bost. Soc. Nat. Hist., IV, 406–408, pl. 32, figs. 1, 2 (1890); Foss. Ins. N. A., I, 382–384, pl. 24, figs. 1, 2 (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinois.

2. PAROMYLACRIS AMPLA.

Pl. III, fig. 4.

Paromylacris ampla Scudd., Mem. Bost. Soc. Nat. Hist., IV, 408, pl. 31, fig. 7 (1890); Foss. Ins. N. A., I, 384, pl. 23, fig. 7 (1890).

From the Lowest Productive Coal-measures at Braidwood, Ill.

3. PAROMYLACRIS TRIANGULARIS sp. nov.

Pl. III, fig. 3.

Represented by a somewhat confused mass of wings, out of which one of the tegmina can be easily distinguished throughout the most of its extent, the tip only broken; this has a remarkably triangular form, the front margin strongly arcuate at the base but beyond straight, the inner margin independently arcuate on the anal area and beyond, the whole wing tapering rapidly and regularly beyond the tip of the anal furrow. The whole wing is a little more than twice as long as its extreme breadth next the base. The mediastinal area is of great extent, terminating about the middle of the distal half of the wing, very broad at the base and gradually tapering, the branches of the vein mostly forked, sometimes doubly forked, and several of them originating beyond the base of the wing, as is the case with other species of Paromylacris, in which respect this genus approaches Necymylacris; the branches are strongly oblique and not very closely crowded; the mediastinal vein is very strongly sinuous, first forks immediately after its separation from the internomedian vein, with which it is united in the basal fifth of the wing, each of its forks again almost immediately subdivided, and their lowermost branches, very deeply forked, send at last about half a dozen nervules to the upper margin, the lowermost striking the tip of the wing; all these branches are but gently sinuous in the apical half of the wing and directed longitudinally upward; the externomedian vein is very similar to the scapular, forking immediately on its freedom from the scapular, each of its branches again forking in the middle of the wing, all having a strongly sinuous course, and after their final forking nearly longitudinal. The internomedian vein is likewise broadly sinuous, and terminates on the inner margin somewhat beyond a point opposite the tip of the mediastinal vein, the main branch having a sinuous course parallel to the lower branches of the externomedian vein; it has three or four simple or forked branches, separating fan-like upon the anal border. The anal furrow is very deeply impressed, very strongly sinuous, and terminates on the inner margin considerably before the middle of the wing; the only veins which can be seen in the anal area are those on the half which is removed from the anal furrow, and they are here straight and parallel.

Length of fragment, 17 mm.; probable length of tegmina, 21.5 mm.; breadth, 10 mm.

A single specimen and its reverse come from the nodules of Mazon Creek, Illinois, and are in the collection of Mr. R. D. Lacoe, bearing the number 2110 *a*, *b*. They come from the Lowest Productive Coal-measures.

4. PAROMYLACRIS CLINTONIANA sp. nov.

Pl. III, fig. 6.

A single well-preserved fore wing with the extreme base and apex destroyed. The form of the tegmina is not so distinctly triangular as in the preceding species, but it tapers with great regularity from the same point, mostly through the arcuation of the inner margin, the front margin being very gently arcuate, so that the tip must fall above the middle, which is very unusual. The mediastinal area is rather short, scarcely extending so far as the anal furrow; very broad at base, it rapidly narrows, and is filled with but few branches, most of which are forked close to the margin, and, as in the species of Paromylacris in general, one at least of the principal branches originates far beyond the base of the tegmina. The scapular vein is the most important in the tegmina occupying with its branches a very considerable portion of its area. It is made up of two clusters which part at no great distance from the base of the tegmina, the uppermost bearing three long branches, part of which are forked next the margin, following the general course of the branches of the mediastinal area. The lower cluster subdivides into two sets at about the end of the basal third of the tegmina—the upper composed of three, the lower of four, long, gently arcuate, upturned, simple branches, which cover the remainder of the front margin as far as the tip of the tegmina; as a whole, the main scapular vein, or rather the main vein of the lower cluster, has a gently sinuous course through the middle of the tegmina, falling below it in its middle portion. The externomedian vein is formed of two slightly compound branches originating from a main stem, which first subdivides a little beyond the first forking of the lower cluster of the scapular vein. Its branches are very gently sinuous, nearly longitudinal, and terminate on the outer and inner borders of the tegmina. The internomedian vein is very gently sinuous, running in a nearly straight course after its basal arcuation to the middle of the apical half of the tegmina, and has five simple, in one case rather deeply forked, straight and oblique branches. The anal furrow is deeply impressed, sharp, and gently arcuate, and, what is most extraordinary, forks just before the tip, and terminates at about the middle of the tegmina. The anal veins are longitudinally oblique, deeply forked, straight or arcuate, rather distant, and subparallel to the basal half of the anal furrow.

This species is remarkable for the slenderness of the tegmina and the curious manner in which they taper by the stronger arcuation of the inner than of the front margin; it is more nearly allied to the preceding species than to any other, but departs widely from it in these respects.

Length of fragment, 15 mm.; probable length of tegmina, 21 mm.; breadth, 8 mm.

Obtained from a coal bank near Clinton, Mo., belonging to th Very Lowest Productive Coal-measures, found within 50 feet of thei extreme base; it is in the collection of Mr. R. D. Lacoe, under th number 2151 *a*.

5. PAROMYLACRIS? PLUTEUS sp. nov.

Pl. III, fig. 2.

A basal fragment of a fore wing appears to belong to a distinc species of Paromylacris, but is referred here doubtfully, as its refe ence depends largely upon the form of the wing, the larger part of th margin of which is conjectural. That it is one of the Mylacridæ i evident from the character of the preserved part of the mediastina area. The direction of the inner margin beyond the anal area, wit the direction and tendencies of the mediastinal and scapular vein indicate that these two veins occupy at least one-half of the tegmina while, if this were the case, the wing could hardly have had the slender form of Lithomylacris, as apparently also it had not the apicall confined area of the externomedian vein. These points would indicat that it fell in Paromylacris, though it is not impossible that it is Necymylacris, its next neighbor. In either case the structure of th anal area is different from anything known in this vicinity, and indicates a species hitherto unknown and of considerable size.

Assuming the margin to be correctly delineated, the mediastina area probably extended to some distance beyond the middle of the tegmina, and the scapular area occupied the rest of the upper half of th tegmina, the main vein of the latter beginning to branch just beyon the basal fifth of the tegmina, where it is bent in its course. The exte nomedian vein runs parallel to the scapular, first branches before th middle of the tegmina, and apparently occupies on the margin almos half as much space as the scapular. The internomedian vein, of whic more can be seen, runs in a very gently arcuate course and terminate far toward the tip of the tegmina, with three or four very inequidi tant, deeply forked or simple, nearly straight or slightly arcuat strongly oblique branches. The anal furrow terminates beyond th middle of the tegmina, and besides being strongly bent next the bas is again gently bent beyond the middle of the remainder, being othe wise nearly straight; and by the fullness of this portion of the inn margin which has an independent curve, the whole area is subequal breadth to near its rapidly tapering extremity; it is filled, at lea away from the anal furrow, with numerous simple or deeply fork veins parallel to its sides, but arcuate apically. The whole area is ful three times as long as broad.

The species appears to fall in the near vicinity of *P. ampla*, but smaller than it, and apparently has a larger development of the inte nomedian area and an earlier branching of the externomedian vein.

Length of fragment, 21.5 mm.; probable length of tegmina, 30 mm.; probable breadth, 16 mm.

A single specimen found in the Butter mine at Pittston, Pa., in the shale over the E coal or Pittston coal by Mr. R. D. Lacoe, in whose collection it bears the number 2040*a*.

5. Genus NECYMYLACRIS.

Necymylacris Scudd., Mem Bost. Soc. Nat. Hist., III, 52–53 (1879); Foss. Ins. N. A., I, 72–73 (1890).

The two known species of this genus both occur in the Pennsylvania coal basin, in the Lowest Productive Coal-measures. No species have been added to the genus since its first description fourteen years ago.

Table of the species of Necymylacris.

Mediastinal vein short; internomedian vein arcuate throughout.....	1. *N. lacoana.*
Mediastinal vein long; internomedian vein straight through most of its course but little arcuate..	2. *N. heros.*

1. NECYMYLACRIS LACOANA.

Necymylacris lacoana Scudd., Mem. Bost. Soc. Nat. Hist., III, 53–54, pl. 5, fig 12 (1879); Foss. Ins. N. A., I, 73–74, pl. 5, fig. 12 (1890).

From the Boston mine, near Pittston, Pa., in the Lowest Productive Coal-measures.

2. NECYMYLACRIS HEROS.

Necymylacris heros Scudd., Mem. Bost. Soc. Nat. Hist., III, 54–56, pl. 5, fig. 9 (1879); Foss. Ins. N. A., I, 74–76, pl. 5, fig. 9 (1890).

From the roof shales of coal C in the Boston mine near Pittston, Pa., in the Lower Productive Coal-measures. By error in the original description it was referred to Cannelton, Pa., in a deposit just below vein C, and its discovery was credited to Mr. Mansfield, when it should have been referred to Mr. Lacoe, in whose collection it bears the number 2006. This error of location was unfortunately repeated in my Fossil Insects of North America, and in my Index to Known Fossil Insects (Bull. 71, U. S. Geol. Survey).

DESCRIPTION OF A FRAGMENT OF A GIGANTIC FORE WING.

MYLACRIDÆ (?) sp.

Pl. II, fig. 4.

The merest fragment of a fore wing, consisting only of the humeral lobe, is shown here to draw attention to an unknown species remarkable for its immense size and for the surface structure. It seems to be pretty certainly a cockroach, and appears to have rather the aspect of one of this group than that of one of the Blattinariæ. The shoulder of the wing is apparently penetrated by a single straight vein without branches, unless the doubly forked bent prominence may be an extrem basal branch. The entire surface is covered with little, circular, shallo punctures, about 0.28 mm. in diameter, slightly more deeply impresse at their margins than centrally, sparsely distributed with considerabl uniformity, but rather more closely crowded toward the margin, wher they lie at an average distance apart of four or five of their diameters The fragment is 25 mm. long, but, being only the merest fragment o the shoulder of a fore wing, must represent one very much larger tha the largest known species, or perhaps one 80 mm. long, at the least.

The specimen comes from the Lowest Productive Coal-measures o Mazon Creek, Illinois, and was sent me for examination by Mr. William Gurley.

BLATTINARIÆ.

This group of Palæoblattariæ was the prevailing type of cockroache in Carboniferous times. In America they are found from the Millston Grit (in scanty numbers, but some variety—two or three genera) to th Trias, where the species, mostly belonging to generic groups characteristic of the Trias, are only two or three times more abundant than in th Millstone Grit, though the culmination of the group is reached in th Permian. In Europe they have been discovered neither so low as th Millstone Grit nor so high as the Trias, but are found throughout th true Productive Coal-measures, as well as in the Barren Coal-measure (where they appear to have culminated) and in the Permian. This latte statement may require some revision when the numerous species foun in the Productive Coal-measures at Commentry, France, are ma known, just as a very different statement regarding the American rock would have had to be made fifteen years ago.

Twelve genera and about 174 species are known, of which 10 gene and about 112 species come from America, and 8 genera and about species from Europe, besides half a dozen undetermined species fro the latter. Six of the genera are common to both worlds, 4 are peculi to America (one of them to the Trias), and 2 to Europe. No species a known to occur on both continents.

6. Genus MICROBLATTINA (μικρός, Blattina, nom. gen.) gen. nov

The apical half of a fore wing from the Rhode Island coal field pr sents such very striking peculiarities that they must be regarded affording sufficient ground for distinct generic reference unless t unknown basal portion should show the veins to be connected in a ve different way from what seems probable. It is as small as the smalle known Carboniferous cockroach, but probably of the normal form. T mediastinal area reaches but little beyond the middle of the tegmina a must be narrow. The scapular vein is simple and straight for mo than half its length, and only when it reaches the end of the medias nal area throws out numerous short branches to the margin. T externomedian vein runs parallel to the scapular and terminates above the apex of the tegmina, emitting numerous inferior, long, straight and parallel, nearly longitudinal branches to the apical margin. The internomedian area is rather narrow, at least in the distal half of the tegmina, subparallel to the inner margin, reaches out as far or nearly as far as the scapular area, and is filled with less crowded, arcuate veins, their convexity apical. The anal area is not preserved.

It is barely possible that what I have here taken for the scapular vein may be an anterior branch of what is regarded as the externomedian, similar to what is found in some of the species of that strange genus Oryctoblattina; but the other parts of the tegmina below this are at decided variance with the peculiar characteristics of Oryctoblattina, and hardly allow room for the development of the lower veins. If my interpretation of the neuration is correct, Microblattina must find a place near Etoblattina, but separated from it and its allies by the remarkable fact that the branches of the externomedian vein are inferior and not superior, just as in Anthracoblattina, where the mediastinal area is long.

A single species is known, coming from the Rhode Island coal field, which belongs in all probability to the Lowest Productive Coal-measures.

MICROBLATTINA PERDITA sp. nov.

Pl. III, fig. 5.

Unfortunately the basal half of the tegmina of this interesting species is destroyed, but the portion preserved shows that the tegmina were of slender ovate form, probably rather more than two and a half times longer than broad; the costal margin is very gently convex, the inner margin nearly straight, and the tip somewhat broadly rounded. The mediastinal area comes into the preserved fragment just enough to show that it was slender, with short, simple, arcuate branches, and that it reached somewhat beyond the middle of the tegmina, terminating somewhat abruptly. The scapular vein, as soon as it begins to fork (just before the extremity of the mediastinal area), approaches the margin less rapidly, increasing its length so that it extends nearly to the apex of the tegmina and crowds closely against the externomedian; its branches are very closely crowded, arcuate and simple, except for the forked basal branch. The externomedian vein first branches probably not beyond the end of the proximal third of the tegmina, and its parallel and straight branches shorten and become more crowded toward the extremity. Some of them are apically forked, and apparently what appear to be the basal ones, each of which is apically forked, are united at their base. What can be seen of the internomedian area is nearly riband-shaped, the main vein approaching the inner margin very gradually until just before its termination, when it curves down to it much as in the case of the mediastinal vein, and its branches, which are more distant than those of other parts of the tegmina and mostly simple, take on the arcuation of this apical part of the vein. None of the anal area is preserved. The externomedian vein and its branches, except next the border, appear in strong relief, while all the others are delicately incised, particularly those of the internomedian area. The whole surface is uniformly black and there is no sign of any other sculpture.

Length of fragment, 4 mm.; probable length of tegmina, 8 mm.; breadth, 3 mm.

From the Lower (?) Productive Coal-measures of East Providence R. I.; in the collection of Mr. R. D. Lacoe, No. 2092*a*.

7. Genus ARCHIMYLACRIS.

Archimylacris Scudd., Daws., Acad. Geol., 2d ed., 388 (1868).

Archimylacris is one of the few genera found in the Millstone Grit as well as later; but, unlike the other genera occurring there, it is at no time a prevailing type, nor does it occur later than the true Productive Coal-measures, nor indeed above its lowest members in the Eastern Interior coal field, in which a single species occurs; the oldest species occurs in the Pennsylvania coal basin, the youngest in the Acadian coal basin. In the light of our present knowledge, therefore, Archimylacris may be looked upon as one of the most primitive types of cockroaches, for it has been found in the earliest beds that have yielded these insects, and no generic type has been extinguished at an earlier epoch than it. Of the genera existing as early as the Lowest Productive Coal-measures, all have been recovered in later rocks excepting Microblattina and Necymylacris, but these two genera are not known, like Archimylacris, at a still earlier epoch. The genus has not yet been recognized in the European rocks.

Table of the species of Archimylacris.

a^1. Tegmina of nearly equal width throughout; anal area hardly extending beyond the basal third of the tegmina.............................. 1. *A. parallela.*

a^2. Tegmina oval throughout, nowhere with parallel margins; anal area extending considerably beyond the basal third of the tegmina.

  b^1. Tegmina fully two and a half times longer than broad, the mediastinal area distinctly tapering throughout its distal half............. 2. *A. paucinervis.*

  b^2. Tegmina only twice as long as broad, the mediastinal area scarcely tapering before its extreme tip.. 3. *A. acadica.*

1. ARCHIMYLACRIS PARALLELA.

Archimylacris parellela Scudd., Mem. Bost. Soc. Nat. Hist., III, 85–87, pl. 6, fig. 6 (1879); Foss. Ins. N. A., I, 105–107, pl. 6, fig. 6 (1890).

From Campbell's Ledge, near Pittston, Pa., near the bottom of the Millstone Grit, where it was discovered by Mr. R. D. Lacoe, in whose collection it bears the number 2007. In the original description it was wrongly referred to the Lowest Productive Coal-measures at Cannelton, Pa., and as collected by Mr. Mansfield. The same error is unfortunately repeated in my Fossil Insects of North America and in my Index to Known Fossil Insects (Bull. 71, U. S. Geol. Survey).

2. ARCHIMYLACRIS PAUCINERVIS.

Archimylacris paucinervis Scudd., Mem. Bost. Soc. Nat. Hist., IV, 411–414. pl. 31, fig. 5 (1890); Foss. Ins. N. A., I, 387–390, pl. 23, fig. 5 (1890).

From the Lower Productive Coal-measures at Mazon Creek, Illinois.

3. ARCHIMYLACRIS ACADICA.

Archimylacris acadica Scudd., Daws., Acad. Geol., 2d ed., 388, fig. 153 (1868); Mem. Bost. Soc. Nat. Hist., III, 84–85, pl. 6, figs. 8, 14 (1879); Foss. Ins. N. A., I, 104–105, pl. 6, figs. 8, 14 (1890).

Found in shale overlying the roof of the main seam of coal at the East River, Pictou, Nova Scotia.

8. Genus SPILOBLATTINA.

Spiloblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 35–36 (1885).

So far as known this genus is peculiar to the American Trias, four species occurring in Colorado. It is very closely related to Etoblattina, and especially to the species of that genus from the latest Carboniferous deposits with open neuration, and it is no doubt an offshoot from that genus, which existed side by side with it or comes of similar parentage with it.

Table of the species of Spiloblattina.

a^1. Scapular vein as far as its penultimate branch almost completely parallel to the costal margin, not receding from it opposite the middle of the adjoining discal stigma.

b^1. Tegmina relatively slender, fully three times as long as broad.

c^1. Scapular faintly approaching the externomedian vein to inclose the stigma between them .... 1. *S. gardineri.*

c^2. Scapular in no way approaching the externomedian vein to inclose the stigma between them .... 2. *S. triassica.*

b^2. Tegmina relatively broad, not over two and a half times longer than broad. 3. *S. guttata.*

a^2. Scapular vein distinctly receding from the costal margin opposite the middle of the adjoining discal stigma .... 4. *S. marginata.*

1. SPILOBLATTINA GARDINERI.

Spiloblattina gardineri Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 36 (1885); Mem. Bost. Soc. Nat. Hist., IV, 461–462, pl. 41, figs. 4, 6, 8, 10 (1890); Foss. Ins. N. A., I, 437–438, pl. 33, figs. 4, 6, 8, 10 (1890).

Trias of Fair Play, Colo.

2. SPILOBLATTINA TRIASSICA.

Spiloblattina triassica Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 36 (1885); Mem. Bost. Soc. Nat. Hist., IV, 461, 462–463, pl. 4, fig. 1 (1890); Foss. Ins. N. A., I, 437, 438–439, pl. 33, fig. 1 (1890).

Trias of Fair Play, Colo.

3. SPILOBLATTINA GUTTATA.

Spiloblattina guttata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 36–37 (1885); M Bost. Soc. Nat. Hist., IV, 461, 463, pl. 41, fig. 2, pl. 42, fig. 14 (1890); Foss. I N. A., II, 437, 439, pl. 33, fig. 2, pl. 34, fig. 14 (1890).

Trias of Fair Play, Colo.

4. SPILOBLATTINA MARGINATA.

Spiloblattina marginata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 37 (1885); M Bost. Soc. Nat. Hist., IV, 461, 464, pl. 41, fig. 3 (1890); Foss. Ins. N. A., I, 440, pl. 33, fig. 3, (1890).

Trias of Fair Play, Colo.

9. Genus ETOBLATTINA.

Etoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 56–58 (1879); Foss. Ins. N. A 76–78 (1890).

This might be termed the typical genus of Palæoblattariæ, or least of Blattinariæ, for it was the prevailing type in the Carboni ous and Permian periods, containing very nearly one-half of the kno Paleozoic cockroaches, and in America almost exactly one-half. Nine seven species have already been recognized—sixty-nine in this coun and twenty-eight in Europe—yet a dozen years ago only two spe were recognized in this country. The great increase is due to the covery of the localities at Richmond, Ohio, and Cassville, West ginia, at which places all but fourteen of the new American spe have occurred. Even in the older rocks it holds a predominant positi being there equaled in number only by Mylacris in America, while Europe it has nearly treble the number of species belonging to G blattina or Anthracoblattina, its nearest numerical neighbors. Its n ber in America is also treble, or a little more than treble, that of G blattina, which follows it among Blattinariæ. Not a single specie common to Europe and America, nor in America has a single one b certainly found at two distinct localities.

In accordance with the fact of its predominance is that of its end ance, since in this country it has been recognized in every deposit wh has yielded remains of cockroaches, from the Millstone Grit, whe single species occurs in the Western Interior coal field,[1] to the Tr from which, in Colorado, two species have been recognized. This not be said of any other genus of cockroaches. It reaches its culmi tion in the Permian, where it is found in astonishing abundance in Dunkard Creek series of West Virginia, whence thirty-six species known from the single locality of Cassville, Monongalia County. Ev coal basin in this country from which cockroaches are known, exc the Acadian, has furnished some species of this genus. In the true I ductive Coal-measures they have been found most abundantly in

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[1] This refers to *E. venusta*, found by Lesquereux in Arkansas deposits regarded by him as o age, but according to the latest surveys it is more probable, Mr. Lacoe informs me, that the de belong to the Lower Productive Coal-measures, in which case the above statement must be mod

Rhode Island basin (eight species); but in the Barren Coal-measures of eastern Ohio seventeen species occur, which is a number larger than that of all the species from the Productive Coal-measures from all American localities combined, indicating the ascendancy of the group.

At the same time, the deposits of the Barren Coal-measures and of the Permian rocks present a new type, already referred to in the Introduction and pretty easily recognized at a glance by the slenderness of the tegmina combined with an exceptional openness of the neuration in the middle of the tegmina, the latter feature somewhat recalling the Triassic Spiloblattina, though with a slightly different effect. So far as the present material shows, this type was the prevailing one in the Barren Coal-measures of this country, but seems to have been only less prevalent in the Permian. It was not peculiar to America, for it appears in the European Permian species, *E. elongata.* I have not attempted, as perhaps I should have done, to bring all these species together in the following table, but they are grouped to a certain extent in a subordinate manner.

In Europe, also, Etoblattina was the predominating type of cockroaches and has been found in every successive series of rocks in which cockroaches have been found, from the Lowest Productive Coal-measures to the Permian. .It seems to have reached its climax in the upper Carboniferous deposits, corresponding largely to our Barren Coal-measures. For assistance in studying the European forms, I have added in the Introduction a section upon the European species of the genus, with a key for their determination.

The following table has been constructed with much difficulty; and while it brings in juxtaposition many of the nearly allied species in a natural manner, it separates at the same time whole series, which a more complete knowledge of the neuration from more perfect examples would have enabled me to arrange in a better order by their judicious mingling. It is offered only as a temporary convenience. The sequence of the species in the table is followed in the text and as far as possible in the plates.

Table of the species of Etoblattina.

a^1. **Relatively broad species**; tegmina distinctly less than two and one-half times longer than broad.
  b^1. **Mediastinal area** less than two-thirds the length of the tegmina.
    c^1. **Internomedian area** terminating far short of the apex of the tegmina.
      d^1. **Mediastinal area** triangular, continuously tapering, reaching only the middle or a little beyond the middle of the tegmina.
        e^1. **Scapular vein** terminating at the very apex of the tegmina; externomedian vein first forking beyond the middle of the tegmina. 1. *E. clintoniana.*
        e^2. **Scapular** vein terminating before the extreme apex of the tegmina; externomedian vein first forking far before the middle of the tegmina .... 2. *E. lata.*
      d^2. **Mediastinal area** vittate, tapering only at extremity, reaching far beyond the middle of the tegmina.

Table of the species of Etoblattina—Continued.

e^1. Externomedian vein first forking at about the middle of the tegmina, branches mostly simple.................... 3. *E. sagitt*

e^2. Externomedian vein first forking near the end of the proximal thi the tegmina, the branches mostly forked.... 4. *E. medi*

c^2. Internomedian area nearly reaching the tip of the tegmina.

d^1. Tegmina only twice as long as broad; veins rather numerous. 5. *E. f*

d^2. Tegmina much more than twice as long as broad; veins very numerou

e^1. Large species, the tegmina exceeding 50 mm. in length; mediastinal reaching far beyond the middle of the tegmina. 6. *E. illu*

e^2. Small species, the tegmina less than 12 mm. long; mediastinal area extending to the middle of the tegmina........ 7. *E. o*

b^2. Mediastinal area at least two-thirds as long as the tegmina.

c^1. Tegmina only twice as long as broad; mediastinal area not more than thirds as long as the tegmina............... 8. *E. scholf*

c^2. Tegmina considerably more than twice as long as broad; mediastinal nearly or quite three-fourths as long as the tegmina.

d^1. Internomedian area terminating far before the tip of the tegmina.

e^1. Scapular and externomedian veins nearly united in basal third of mina; internomedian vein normal............. 9. *E. de*

e^2. Scapular and externomedian veins clearly distinct throughout; inte median vein peculiar.

f^1. Externomedian vein simple, unbranched; internomedian vein reinfo by a supplementary branched superior stem. 10. *E. stri*

f^2. Externomedian vein abundantly branched; internomedian vein strongly sinuate, the area apically very slender. 11. *E. cla*

d^2. Internomedian area extending nearly to the tip of the tegn 12. *E. ven*

a^2. Relatively slender species, the tegmina two and one-half or more times lo than broad.[1]

b^1. Tegmina distinctly less than three times as long as broad.

c^1. Internomedian area not or hardly attaining the apical margin.

d^1. Veins in center of tegmina much more widely separated than those o apical margin.

e^1. Mediastinal area considerably more than two-thirds the length o tegmina.

f^1. Internomedian branches distant and most of them forked. 13. *E. balt*

f^2. Internomedian branches crowded and most of them simple. 14. *E. pat*

e^2. Mediastinal area somewhat or distinctly less than two-thirds the len of the tegmina.

f^1. Scapular and externomedian veins first branching at very une distances from the base.

g^1. Externomedian and internomedian branches very crowded, mor than the branches of the other veins..... 15. *E. mucron*

g^2. Externomedian and internomedian branches, especially the lat not crowded, and not more so than the others. 16. *E. del*

f^2. Scapular and externomedian viens first forking side by side. 17. *E. occident*

d^2. Veins in center of tegmina scarcely more widely separated than thos the apical margin.

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[1] In a few species the tegmina are barely two and one-half times, in a few others they are more three times longer than broad.

Table of the species of Etoblattina—Continued.

e^1. Mediastinal area less than three-fifths the length of the tegmina.

f^1. Tegmina sparsely veined.............................. 18. *E. exigua.*

f^2. Tegmina abundantly veined.

g^1. Main scapular vein nearly straight.................. 19. *E. sp.* (R. I.).

g^2. Main scapular vein strongly arcuate.

h^1. Scapular vein subparallel to the costal margin in the basal half of the tegmina; its branches oblique...... 20. *E. jeffersoniana.*

h^2. Scapular vein forming a considerable angle with the costal margin in the basal half of the tegmina, its branches longitudinal .... 21. *E. residua.*

e^2. Mediastinal area more than three-fifths the length of the tegmina.

f^1. Anal furrow terminating hardly or not beyond the end of the proximal two-fifths of the tegmina.

g^1. Veins of internomedian area not crowded; scapular and externomedian veins well separated from the base .. 22. *E. funeraria.*

g^2. Veins of internomedian area crowded; scapular and externomedian veins united in the proximal fourth of the tegmina.
23. *E. expuncta.*

f^2. Anal furrow terminating scarcely short of the middle of the tegmina.
24. *E. gorhami.*

c^2. Internomedian area distinctly attaining the apical margin.

d^1. Veins in center of tegmina widely separated.

e^1. Mediastinal area less or scarcely more than one-half the length of the tegmina.

f^1. Internomedian vein nearly straight, nearly all the branches simple.

g^1. Internomedian area narrow, in the middle less than one-fourth the width of the tegmina....................... 25. *E. aperta.*

g^2. Internomedian area relatively broad, in the middle nearly one-third the width of the tegmina.................... 26. *E. fasciata.*

f^2. Internomedian vein strongly sinuate, many of the branches forked, often doubly forked.

g^1. Mediastinal vein arcuate beyond base; scapular vein scarcely bent at the origin of the first two branches .... 27. *E. ramosa.*

g^2. Mediastinal vein straight beyond base; scapular vein distinctly bent at the origin of the first two branches .... 28. *E. willsiana.*

e^2. Mediastinal area nearly or quite three-fifths the length of the tegmina.

f^1. Externomedian vein first branching close to the middle of the tegmina.

g^1. Internomedian vein arcuate throughout, continually approaching the margin.............................. 29. *E. lesquereuxii.*

g^2. Internomedian vein sinuous by a distinct apical extension, subparallel to the margin.

h^1. The branches of the mediastinal vein mostly originate from the vein itself.

i^1. Main scapular vein broadly sinuate; internomedian vein nearly reaching the very apex of the tegmina.

j^1. Costal margin broadly arcuate; first two branches of scapular vein widely separated at origin............ 30. *E. maledicta.*

j^2. Costal margin strongly arcuate; first two branches of scapular vein closely approximate at base.......... 31. *E. benedicta.*

i^2. Main scapular vein rigidly straight through most of its course; internomedian vein falling considerably short of the apex.
32. *E. funesta.*

h^2. Most of the branches of the mediastinal vein arise from its first branch, which imitates the mediastinal vein.33. *E. exsensa.*

Table of the species of Etoblattina—Continued.

f^2. Externomedian vein first branching well within the proximal half of the tegmina.

g^1. Mediastinal vein about three-fifths the length of the tegmina; scapular vein forking before the externomedian vein. 34. *E. tenuis.*

g^2. Mediastinal vein two-thirds the length of the tegmina; externomedian vein forking before the scapular vein.. 35. *E. hustoni.*

d^2. Veins in center of tegmina not widely separated.

e^1. Mediastinal area distinctly less than two-thirds the length of the tegmina.

f^1. Anal furrow striking the margin not beyond the end of the proximal third of the tegmina.

g^1. Internomedian area more than one-third the breadth of the tegmina in the middle of their distal half........ 36. *E. persistens.*

g^2. Internomedian area less than one-third the breadth of the tegmina in the middle of their distal half......... 37. *E. eakiniana.*

f^2. Anal furrow striking the margin but little before the middle of the tegmina.

g^1. Small species; tegmina with strongly convex costa; externomedian vein first branching before the tip of the anal furrow and well before the middle of the tegmina..... 38. *E. accubita.*

g^2. Large species; tegmina with gently convex costa; externomedian vein first branching beyond the tip of the anal furrow and scarcely before the middle of the tegmina... 39. *E. mazona.*

e^2. Mediastinal area fully two-thirds the length of the tegmina.

f^1. Scapular vein first forking scarcely before the externomedian vein.

g^1. Mediastinal area scarcely if any more than two-thirds the length of the tegmina.

h^1. Internomedian area reaching the apex of the tegmina by the retroarcuation of the main vein.............. 40. *E. expulsata.*

h^2. Internomedian area reaching only the extreme limit of the apical margin of the tegmina, without noticeable retroarcuation.

i^1. Mediastinal branches excessively longitudinal and crowded; scapular branches mostly forked............... 41. *E. gratiosa.*

i^2. Mediastinal branches normal and not crowded; scapular branches all simple .... 42. *E. macerata.*

g^2. Mediastinal area almost or quite three-fourths the length of the tegmina................................. 43. *E. immolata.*

f^1. Scapular vein first forking at a noticeable distance before the externomedian vein.

g^1. Anal furrow striking the margin scarcely beyond the end of the proximal two-fifths of the tegmina.

h^1. Mediastinal area three-fourths the length of the tegmina, tapering rather abruptly........................... 44. *E. mactata.*

h^2. Mediastinal area scarcely if any more than two-thirds the length of the tegmina, tapering gently.......... 45. *E. communis.*

g^2. Anal furrow striking the margin scarcely before the middle of the tegmina................................ 46. *E. sp.* (Colo.).

b^2. Tegmina almost or fully three times as long as broad.

c^1. Mediastinal area less than two-thirds the length of the tegmina.

d^1. Internomedian vein more or less, often considerably, sinuate, much of the apical portion nearly or quite parallel to the inner margin, and rarely falling at all short of the apex of the tegmina.

Table of the species of Etoblattina—Continued.

e^1. Scapular vein forking before, generally long before, the externomedian; anal area normal.
f^1. Mediastinal area less than half as long as the tegmina. 47. *E. hastata.*
f^2. Mediastinal area more than half as long as the tegmina.
g^1. Costal margin nearly straight throughout the middle half[1].
h^1. Internomedian area scarcely narrowing in its proximal half. 48. *E. marginata.*
h^2. Internomedian area rapidly narrowing in its proximal half. 49. *E. gracilenta.*
g^2. Costal margin regularly arcuate throughout........ 50. *E. exsecuta.*
e^2. Scapular vein first forking later than the externomedian; anal area exceptionally long and narrow................. 51. *E. arcta.*
d^2. Internomedian vein nearly or quite straight, the area tapering almost regularly and falling considerably, sometimes far, short of the apex of the tegmina.
e^1. Internomedian vein terminating well beyond the middle of the distal half of the tegmina.
f^1. Main scapular vein strongly sinuous.................... 52. *E. stipata.*
f^2. Main scapular vein nearly straight throughout.
g^1. Anal furrow striking the inner margin well beyond the end of the proximal third of the tegmina............ 53. *E. prædulcis.*
g^2. Anal furrow striking the inner margin far before the end of the proximal third of the tegmina................. 54. *E. variegata.*
e^2. Internomedian vein terminating at or before the middle of the distal half of the tegmina.
f^1. Externomedian vein strongly bent where first forked and thereafter very oblique.............................. 55. *E. hilliana.*
f^2. Externomedian vein gently bent where first forked and thereafter but little or scarcely oblique.
g^1. Tegmina scarcely tapering apically before the distal fourth, nearly equal in the middle half; internomedian area extending but little further than the mediastinal.
h^1. Tegmina more than three times as long as broad; internomedian area exceptionally narrow; externomedian vein first branching but little beyond the tip of the anal furrow. 56. *E. angusta.*
h^2. Tegmina less than three times as long as broad; internomedian area of normal breadth; externomedian vein first branching well beyond the tip of the areal furrow.... 57. *E. macilenta.*
g^2. Tegmina tapering from the middle, the middle half fusiform; internomedian area extending very much farther than the mediastinal.
h^1. Internomedian area in middle less than one-third the breadth of tegmina; anal area excessively slender........ 58. *E. exilis.*
h^2. Internomedian area in middle more than one-third the breadth of the tegmina; anal area normal................ 59. *E. rogi.*
c^2. Mediastinal area more than two-thirds the length of the tegmina.
d^1. Internomedian vein reaching nearly or quite to the apical margin of the tegmina.
e^1. Main veins separated in the center of the tegmina by hardly wider intervals than the branches near the apical margin.
f^1. Scapular and externomedian veins distinct throughout.

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[1] This is not clear, but probable, in *E. marginata.*

Table of the species of Etoblattina—Continued.

g^1. Internomedian area just failing to reach the apical margin.
  h^1. Mediastinal branches not crowded; internomedian branches rarely forked; anal area elongate .... 60. *E. expugnata.*
  h^2. Mediastinal branches crowded, internomedian branches mostly forked; anal area abbreviate .... 61. *E. obatra.*
g^2. Internomedian area distinctly reaching the apical margin.
  h^1. Mediastinal branches crowded, mostly forked; scapular and externomedian veins first forking close together 62. *E. imperfecta.*
  h^2. Mediastinal branches not crowded, rarely forked; scapular vein first forking well before the externomedian.. 63. *E. secreta.*
f^2. Scapular and externomedian veins united in basal fourth or more of the tegmina .... 64. *E. reliqua.*
e^2. Main veins separated in the center of the tegmina by much wider intervals than the branches near the apical margin.
  f^1. Scapular and externomedian veins both first forking in the distal half of the tegmina .... 65. *E. invisa.*
  f^2. Scapular and externomedian veins both first forking well within the proximal half of the tegmina.
    g^1. Externomedian vein distinctly oblique, the branches distinctly superior.
      h^1. Internomedian vein strongly sinuate, curving just beyond the anal furrow in an opposite sense to it .... 66. *E. occulta.*
      h^2. Internomedian vein arcuate almost to the tip.... 67. *E. latebricola.*
    g^2. Externomedian vein longitudinal, the branches purely furcate and longitudinal .... 68. *E. defossa.*
d^2. Internomedian vein falling distinctly short of the apical margin of the tegmina .... 69. *E. recidiva.*

The hind wings described in the following list are not included in the table, nor is the fragment shown on Pl. XII, fig. 2.

1. ETOBLATTINA CLINTONIANA sp. nov.

Pl. IV, fig. 1

Tegmina broad subovate, two and a quarter times as long as broad, the costal margin beyond the well-shouldered base very faintly convex, the anal area full, and beyond it the inner margin symmetrical with the costal; the apex well rounded. Mediastinal area triangular, rapidly tapering, terminating before the middle of the tegmina and slightly before the tip of the anal furrow; the vein has only three or four simple, nearly straight, very oblique branches. The scapular vein runs subparallel to and distant from the costal margin nearly through the middle of the tegmina, straight in the greater part of its course, but arcuate in opposite senses at the two extremities, terminating exactly at the apex of the tegmina; it first forks as far toward the base as the internomedian vein, and has about eight gently arcuate branches, mostly simple, but others more or less deeply or doubly forked, all very oblique and the distal ones sublongitudinal. The externomedian vein runs parallel to the preceding, diverging but little from it when, beyond the middle of the tegmina, it first branches and is unimportant, having but a couple of branches, one simple, the other forked. The internomedian vein is gently arcuate, runs parallel to the externomedian and strikes the inner margin just before the distal tenth of the tegmina; it has five or six mostly simple sweeping branches. The anal furrow is rather strongly impressed, very regularly and strongly arcuate, and nearly reaches the middle of the tegmina; the anal veins are numerous, arcuate, crowded, mostly simple, and avoid the space adjoining the anal furrow.

Length of tegmina, 22.5 mm.; breadth at anal furrow, 10 mm. (broader at the middle of the anal area).

The surface of the tegmina, especially in the distal half and in the internomedian area, is covered by very delicate cross lines between the nervures, not very closely crowded.

This species, represented by a nearly perfect fore wing, is more nearly allied to the European *E. primæva* than to any of ours; it is about two-thirds its size and differs in its lesser breadth, the greater brevity of the mediastinal area, and the far later forking of the externomedian vein.

From the Lowest Productive Coal-measures at Gilkerston Ford, near Clinton, Mo., collected by David White, United States Geological Survey. No. 2182; original No. 412.

2. ETOBLATTINA LATA sp. nov.

Pl. IV, fig. 2.

Although the only known specimen of this species is imperfect by the loss of both extremities of the tegmina, they are apparently a little less than two and a half times as long as broad, the costal margin rather gently convex, the inner margin straight, and the apex well rounded. The mediastinal area is distinctly triangular and tapering throughout, terminating shortly before the distal end of the middle fifth of the tegmina, with few and distant, straight, very oblique, simple or forked branches. The scapular vein is broadly sinuate throughout, terminates at a little distance before the extreme apex of the tegmina, first branches within the basal fourth of the tegmina, and has about five nearly longitudinal, simple, forked, or doubly forked branches. The externomedian vein is also broadly sinuate, first forks opposite the tip of the anal furrow, and has four or more longitudinal, gently arcuate, simple or forked branches occupying the apical margin. The internomedian vein is feebly sinuate and probably terminates well before the extreme apex of the tegmina, and has six or seven mostly simple, strongly oblique, nearly straight branches, the first of which, deeply forked, originates far before the others, close to the very base of the vein. The anal furrow is deeply impressed, bent arcuate, and strikes the inner margin at about the end of the proximal third of the tegmina; the anal veins are simple, very gently arcuate, and subequidistant. The anal and internomedian veins are finely traced in black on the surface of the tegmina, otherwise of the color of the dark stone; and there are straight and crowded delicate cross lines between all the nervures.

Length of fragment, 10.5 mm.; probable length of tegmina, 16 mm.; breadth, 6.75 mm.

This species is most nearly allied to *E. sagittaria*, a considerably larger species, but differs from it in the form of the tegmina, the triangular and not vittate form of the mediastinal area, the far earlier branching of the externomedian vein, and the considerable difference in the character of the internomedian area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; No. 2099*a*.

3. ETOBLATTINA SAGITTARIA sp. nov.

Pl. IV, fig. 3.

The tegmina are twice as long as broad, have an ovate form, tapering rather regularly from about the middle of the anal area, with subacuminate rounded apex; the costal margin is gently arcuate, as is also the distal half of the inner margin. The mediastinal area is narrow, in its middle hardly a fifth the breadth of the tegmina, and ends with the middle fifth of the same; its branches are few, distant, simple, straight, and oblique. Scapular vein gently sinuate, subparallel to the inner margin and terminating almost at the very apex of the tegmina; it has five branches, the first arising within the proximal fourth of the tegmina, the second about the middle of the tegmina, these two forked or doubly forked, the remainder arising at regular intervals and simple; all are longitudinally oblique and gently arcuate. The externomedian vein is strongly sinuate, especially arcuate at base, first forks about the middle of the tegmina and has from three to five simple or forked, straight, longitudinal branches, arising at equal intervals in the distal half of the tegmina. The internomedian vein is strongly sinuate, parallel to the preceding but slightly approaching it distally, where the area is prolonged and attenuated, reaching the distal fifth of the tegmina; the seven or eight branches are mostly simple, slightly arcuate and oblique, the distal branches more strongly than the basal. The anal furrow is feebly impressed, very regularly and strongly arcuate and strikes the inner margin just beyond the end of the proximal two-fifths of the tegmina; the anal branches are few, subequidistant, arcuate, and simple. The surface of the tegmina shows no sign of cross-lining.

Length of preserved portion of tegmina, 11 mm.; probable length of tegmina, 12.8 mm.; breadth, 6.5 mm.

In its form and the apically attenuate internomedian area this species closely resembles *E. deanensis* of England, but differs strikingly from it in both the mediastinal and externomedian areas. It nevertheless appears to be closer to that than to any other European species, though it more nearly approaches our *E. mediana.* Were it not for the apical attenuation of the internomedian area, it would bear a strong resemblance to a Petrablattina, on account of the simplicity and longitudinality of its straight externomedian branches.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; four specimens, Nos. 2100 *a*, *b*, *c*, *d*.

4. ETOBLATTINA MEDIANA.

Pl. IV, fig. 4.

Tegmina somewhat less than two and one-half times as long as broad, tapering rather rapidly on apical half, subacuminate at apex, the costal margin rather strongly arcuate, the inner margin nearly straight to the end of the internomedian area and then rapidly arcuate. Mediastinal area vittate, terminating at the distal end of the middle fifth of the tegmina with somewhat distant, nearly straight, strongly oblique, mostly simple branches. Scapular vein gently arcuate beyond the base, terminating well short of the apex of the tegmina, with only three distant inequidistant branches, the first arising far toward the base, apically doubly forked, the next near the middle of the tegmina and deeply forked, the third simple. The externomedian vein is of unusual importance and has a sinuous course to make room for the apical extension of the following vein; it first forks not far beyond the middle of the proximal half of the tegmina and has four inequidistant, apically arcuate branches, which fork at unequal distances from the margin, the last simple. The internomedian vein is sinuate by the apical extension of its attenuated tip and reaches to the distal fifth of the tegmina; its branches are few, distant, arcuate, simple or deeply forked, the proximal oblique, the distal nearly longitudinal. The anal furrow is very feebly impressed, greatly arcuate, and strikes the inner margin not far beyond the end of the proximal fourth of the tegmina; the anal area is not preserved. The surface of the tegmina is marked with closely crowded delicate cross lines between the nervures, and the latter are faintly and finely traced in black. The basal third of the tegmina is lost in the single specimen known.

Length of fragment, 12 mm.; probable length of tegmina, 17 mm.; breadth, 7.5 mm.

This species differ from *E. sagittaria* by the far greater importance of the externomedian area, but seems to be more nearly allied to it than to any other species.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; No. 2101 *a–b*.

5. ETOBLATTINA FOSSA sp. nov.

Pl. IV, fig. 5.

Tegmina scarcely more than twice as long as broad, the inner margin nearly straight, the costal rather strongly convex, the apex broadly rounded. Mediastinal area broad at base, rapidly narrowing beyond the middle, terminating just beyond the middle of the tegmina; the branches few, mostly simple, straight and very oblique. Scapular vein strongly sinuate, in the middle subparallel to the costal margin, terminating close to the apical margin, first branching in the middle of the proximal half of the tegmina, with few gently arcuate branches, but the proximal ones deeply forked or compound, and all longitudinally oblique. Externomedian vein rather strongly sinuate, first branching a little before the middle of the tegmina, the branches few but mostly doubly forked and longitudinally arcuate. Internomedian vein parallel to the externomedian, terminating a little before the extreme apex of the tegmina, two branches which are doubly forked thrown off in the proximal fourth of the tegmina, and only one or two (simple?) beyond. Anal furrow finely impressed, regularly arcuate but apically straight and nearly transverse, terminating beyond the proximal two-fifths of the tegmina. The surface is glistening, carbonaceous, and distinctly marked with crowded and very irregular delicate cross lines, in places becoming reticulate. The lower part of the tip of the tegmina is broken off from the only specimen known, and the shoulder of the base is lost, with the anal area.

Length of fragment, 12.4 mm.; probable length of tegmina, 14 mm.; breadth, 6.75 mm.

This species closely resembles the next two, but the neuration is much less close, and the branching of the internomedian vein very different, most of the area being taken up with the offshoots of the first two branches.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 182.

6. ETOBLATTINA ILLUSTRIS.

Pl. IV, fig. 11.

Etoblattina illustris Scudd., Bull. U. S. Geol. Surv., No. 101, 12-13, pl. 2*i* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket (?), R. I.

7. ETOBLATTINA OVATA sp. nov.

Pl. IV, fig. 6.

Tegmina of a very symmetrical long ovate form, somewhat more than twice as long as broad. Mediastinal area fully half as long as the tegmina, the branches of the vein not numerous, gently arcuate, and mostly simple. Scapular vein nearly straight, with only a gentle arcuation at the extremities, subparallel to the costal margin and terminating scarcely before the extreme apex of the tegmina; it first branches in the middle of the proximal half of the tegmina, and has half a dozen very oblique and straight branches, simple or doubly forked. Externomedian vein straight and longitudinally oblique in its middle half, but arcuate at the extremities, terminating a little below the apex of the tegmina, thus occupying but an inconsiderable space on the margin; in the single specimen before me it first forks a little before the middle of the tegmina and has four branches, but the first is blind, the second deeply forked, the others simple, and all longitudinal. The internomedian vein is broadly sinuate, especially by the apical prolongation of the area, nearly to the apex of the tegmina, and is supplied with numerous branches, all, so far as can be seen, simple and arcuate, the proximal oblique, the distal longitudinal. The anal furrow is rather deeply impressed, strongly arcuate and probably mesially bent, terminating a little before the middle of the tegmina; the anal veins are numerous and crowded, strongly arcuate, and most of them very deeply forked. The carbonaceous black surface is indistinctly marked with rather close and irregular tremulous cross lines.

Length of fragment, 13 mm.; probable length of tegmina, 14.5 mm.; breadth, 6.25 mm.

This species is tolerably distinct from any of the known species of Etoblattina, but is perhaps most nearly allied to *E. illustris*, from which it differs in every known point of structure, and in particular in its feebly developed externomedian area, not to mention the extreme disparity in size, the present species having tegmina less than one-fifth as long as *E. illustris*.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2102*a*.

8. ETOBLATTINA SCHOLFIELDI.

Pl. IV, fig 7.

Etoblattina scholfieldi Scudd., Bull. U. S. Geol. Surv., No. 101, 15, pl. 2, fig. *b* (1893).

From the Lower (?) Productive Coal-measures of East Providence, R. I.

9. ETOBLATTINA DEBILIS sp. nov.

Pl. IV, fig. 8.

Tegmina oval, tapering from before the middle, about two and one-fourth times longer than broad, the costal border strongly convex, especially in basal half, the inner margin nearly straight, except at base and apex, and the apex probably well rounded. Mediastinal area vittate, about a fourth of the width of the tegmina, apically tapering gradually, and terminating scarcely beyond the distal end of the middle third of the tegmina, the branches tolerably numerous, straight, oblique or very oblique, and rarely forked. The scapular and externomedian veins run so closely together in the proximal fourth of the tegmina as often with difficulty to be distinguished; beyond this the former is nearly straight and ends scarcely above the extreme apex of the tegmina; the branches are simple or deeply forked, nearly straight and oblique, the first originating sometimes as early as the middle of the proximal half of the tegmina. The externomedian vein, nearly as soon as it distinctly parts from the scapular, is straight and longitudinally oblique with three or four simple or forked straight branches parallel to the scapular vein. The internomedian vein is strongly arcuate at base, straight beyond, and terminates not far from the middle of the distal half of the tegmina; its branches are only three or four in number, but they are often deeply forked or doubly forked, nearly straight, and with a general oblique course. The anal furrow is very sharply depressed, very strongly arcuate before the straight apex, which strikes the inner margin at the end of the proximal two-fifths of the tegmina; the anal veins next the furrow are bent arcuate, the distant ones oblique and nearly straight, all simple, and the latter much more crowded than the former. The basal portion of the mediastinal vein is almost as much impressed as the anal furrow, and the interval between it and the scapular vein at the extreme base of the tegmina roundly ridged. The surface of the tegmina is of the color of the stone, but the internomedian and anal veins are finely traced in black; excessively crowded fine cross lining appears everywhere between the nervures, especially in the faintly vaulted anal area.

Length of largest fragment, 13 mm.; probable length of tegmina, 17 mm.; breadth, 7.5 mm.

This species somewhat resembles *E. strigosa*, especially in the close basal alliance of the scapular and externomedian veins, but it differs considerably from any species with which one would be disposed to compare it. One of the specimens (No. 2103 *c–d*) does not have the scapular and externomedian veins united to so great a distance as described.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; three specimens, Nos. 2103 *a–b*, *c–d*, *e*.

10. ETOBLATTINA STRIGOSA.

Pl. IV, fig. 10.

Etoblattina strigosa Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 52–53 (1889).

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone in the valley of Wills Creek, Richmond, Jefferson County.

11. ETOBLATTINA CLARKII.

Pl. V, fig. 10.

Etoblattina clarkii Scudd., Bull. U. S. Geol. Surv., No. 101, 14–15, pl, 2, fig. *j* (1893

From the Lower (?) Productive Coal-measures at Pawtucket, R. I.

12. ETOBLATTINA VENUSTA.

Blattina venusta Lesq., Second Rep. Geol. Ark., 314, pl. 5, fig. 11 (1860).
Etoblattina venusta Scudd., Mem. Bost. Soc. Nat. Hist., III, 70–72, pl. 6, fig. 12 (1879); Foss. Ins. N. A., I, 90–92, pl. 6, fig. 12 (1890).

Frog Bayou, Arkansas, in deposits regarded by Lesquereux[1] as having from 200 to 300 feet of Millstone Grit above them, but which I am informed by Mr. R. D. Lacoe, basing his judgment upon the maps and reports of the later Arkansas surveys, more probably belong to the true Productive Coal-measures, or the upper "coal-bearing division" of Winslow. Final reports on the district have not yet been published, and another season's fieldwork may be required to furnish a complete demonstration. In the present paper I have assumed provisionally the accuracy of Lesquereux's determination, though the presumption is not in its favor.

13. ETOBLATTINA BALTEATA.

Gerablattina balteata Scudd., Mem. Bost. Soc. Nat. Hist., III, 110–112, pl. 6, figs. 9, 10 (1879); Rep. Second Geol. Surv. Penn. PP, 104, pl. 38, figs. 5, 5*a* (1880); Foss. Ins. N. A., I, 130–132, pl. 6, figs. 9, 10 (1890).
Etoblattina balteata Scudd., Proc. Bost. Soc. Nat. Hist. XXIV, 46, 48 (1889).

From the Waynesburg coal (Lower Permian) of Cassville, W. Va.; and perhaps from Bellaire, Ohio, in the Barren Coal-measures in shales 20 feet below the Pittsburg coal.

The type of the species comes from Cassville. The fragment from Bellaire is composed of the anal area only, and it is quite impossible to tell whether it belongs to this or an allied species.

14. ETOBLATTINA PATIENS sp. nov.

Pl. IV, fig. 9.

Tegmina slender, nearly three times as long as broad, the costal margin not very strongly but very regularly arcuate, the inner margin nearly straight, the apex probably well rounded, tapering from the middle of the tegmina. Mediastinal area vittate, the vein parallel to the margin, apically tapering and reaching nearly to the middle of the distal half of the tegmina, the branches moderately numerous, oblique, straight, and simple. The scapular vein is unusually straight and terminates scarcely above the extreme apex of the tegmina; it divides in the middle of the proximal half of the tegmina into two longitudinal branches, each further subdivided only beyond the middle of the tegmina, the upper or first branch into a double fork, simulating the appearance of the apical part of the mediastinal vein, the lower or main stem with several inequidistant branches, some at least probably forked. Externomedian vein also very straight and longitudinally oblique, first forking before the middle of the tegmina, the branches distant, only three or four in number, the first two oblique, the others compoun Internomedian vein similarly straight, though probably a little arcuat at tip (where it is broken in the only specimen seen), terminating pro ably a little before the apical margin of the tegmina, the branch rather numerous, subequidistant, increasingly oblique the farther fro the anal area, arcuate and simple. Anal furrow delicately impresse not greatly arcuate, terminating at the distal end of the proximal tw fifths of the tegmina. The surface of the tegmina is very broad banded with black along the veins, between which run rather close crowded, delicate, irregular cross lines, conspicuous only in the blac ened portions.

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[1] See Geol. Mag., V, 177 (1868).

Length of fragment, 13 mm.; probable length of tegmina, 18 mm breadth, 6.4 mm.

This species is closely allied to *E. balteata*, from which it differs pri cipally in the far more numerous and simple internomedian branche and in the earlier forking of the scapular vein; it is also related not distantly to the European *E. russoma* and probably has the apex, as there well filled with numerous veinlets, but the costal margin is far less arcuate, and the main veins in *E. russoma* are not nearly so straight as here. It also shows many points of resemblance to our *E. occulta.*

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2104 *a–b*.

15. ETOBLATTINA MUCRONATA sp. nov.

Pl. V, fig. 3.

A large part of the base is lost from the only specimen of this species seen, but the tegmina are apparently somewhat less than three times as long as broad, of a lanceolate form, the apical half tapering somewhat rapidly and regularly, the apex subacuminate and sharply rounded. The mediastinal area is triangular, apically attenuate, reaching nearly to the distal end of the middle fifth of the tegmina, first forking at about the end of the proximal third of the tegmina, with three or four arcuate, longitudinally oblique, deeply forked or doubly forked branches; the apical branch simple. Externomedian vein very feebly sinuate; first forking at about the middle of the tegmina, with four branches having a course similar to that of the scapular branches, simple or forked; the last multiforked. Internomedian vein very feebly sinuate, almost straight, terminating well before the apex, but at the edge of the apica margin, with very numerous, nearly straight, crowded, simple, obliqu branches. The surface of the tegmina is uniformly blackish, with th feeblest possible signs of distant straight cross lines between th nervures. The anal area and furrows are lost.

Length of fragment, 9.5 mm.; probable length of tegmina, 13.5 mm. breadth, 5 mm.

This species bears a certain resemblance to *E. expuncta*, but is of muc *slenderer form*, more tapering apically, and has more oblique and mo complicated externomedian branches; the internomedian area is also longer in the present species; besides which there is in *E. expuncta* no such wide separation of the nervures in the middle of the wing as here.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; No. 2105 *a–b*.

16. ETOBLATTINA DETECTA sp. nov.

Pl. IV. figs. 12, 13.

Tegmina long ovate, considerably less than three times as long as broad, with the costal margin very strongly arcuate at base, nearly straight beyond the proximal third of the tegmina, the inner margin nearly straight, and the apex subacuminate, falling above the middle line of the tegmina. The mediastinal area is very slender and tapering, terminating well before the distal end of the middle third of the tegmina, with few very oblique, straight, simple branches. Scapular vein nearly straight, terminating near the beginning of the apical margin, first forking well before the middle of the tegmina with about four very inequidistant, longitudinal or longitudinally oblique, simple or deeply forked, sometimes doubly forked, straight or slightly arcuate branches. Internomedian vein distant from the externomedian, straight or sinuate, terminating at about the middle of the distal half of the tegmina with generally simple, rather distant, parallel, oblique, arcuate branches. Anal furrow very strongly and very regularly arcuate, rather deeply impressed, terminating not far from the middle of the proximal half of the tegmina; anal veins irregularly arcuate, inequidistant and subparallel, simple and moderately numerous. The surface of the tegmina is heavily banded with black along the nervures, so broadly as often to blend with the neighboring bands, and the interspaces are traversed pretty regularly and closely with distinct straight cross lines.

Length of tegmina, 16.5 mm.; breadth, 6.25 mm.

Two specimens are before me which differ considerably in the internomedian vein, which in one is straight and apically divaricate from the externomedian vein, and this latter forks relatively far from the base, while in the other specimen the internomedian vein is sinuous, apically convergent with the externomedian vein, and this latter forks relatively near the base. The latter specimen is nearly perfect; the former has lost a little of both base and apex.

This species is more nearly allied to the two preceding than to any others known to me, but is sufficiently distinguished from *E. mucronata* by its form and the relatively small number of internomedian branches, as well as by the earlier forking of the externomedian vein, and from *E. patiens* by the very different mediastinal area. It is, on the whole, nearer the latter.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2106 *a–b*, *c*.

17. ETOBLATTINA OCCIDENTALIS.

Etoblattina occidentalis Scudd., Mem. Bost. Soc. Nat. Hist., IV, 410–411, pl. 32, fig. 4 (1890); Foss. Ins. N. A., I, 386–387, pl. 24, fig. 4 (1890).

Lawrence, Kans. Dr. S. W. Williston, of the University of Kansas, tells me that the locality at which it was found, in the old fair ground near the city, is at about the middle of the true Carboniferous of Kansas, as nearly as he can make it out.

18. ETOBLATTINA EXIGUA sp. nov.

Pl. V, fig. 4.

Tegmina somewhat less than three times as long as broad, the inner margin straight, the costal margin strongly arcuate, but much less so in the apical half, the apex probably well rounded. Mediastinal area triangular, the vein being straight and terminating well before the distal end of the middle third of the tegmina; the branches are obscure but probably very longitudinally oblique and few in number. The scapular vein is broadly sinuate, terminating just above the extreme apex of the tegmina; it has but very few, three or four, very longitudinally oblique, feebly arcuate branches, mostly simple, their course parallel to the mediastinal vein. The externomedian vein is arcuate and has but two longitudinal branches, the first originating in the center of the tegmina and forked to its root, the other not far before the margin; probably all three of these are forked next the apical margin (broken in the only specimen). The internomedian vein is arcuate at first, straight apically, and terminates a little beyond the middle of the distal half of the tegmina; the branches are few in number and distant, the first one deeply forked, the others simple, straight, and oblique. The anal furrow is not very strongly arcuate, deeply impressed only in its basal half, and terminates a little beyond the end of the proximal third of the tegmina; the anal veins are few, distant, simple, parallel, subequidistant, and arcuate. The basal portion of the mediastinal vein is impressed as deeply as the anal furrow, while the basal portions of the externomedian and internomedian veins are borne on the summit of a ridge between them. The surface of the tegmina is blackish brown and all the nervures are bordered for fully a fourth of the distance to the neighboring nervures with black, more distinctly in the anal area than elsewhere; and there is a feeble very crowded straight cross lining between the nervules.

Length of fragment, 9.25 mm.; probable length of tegmina, 11.75 mm.; breadth, 4.2 mm.

This species is remarkable for the paucity of its neuration, and is not closely allied to any other species yet known.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2107 *a–b*.

19. ETOBLATTINA sp.

Pl. V, fig. 2.

Etoblattina sp. Scudd., Bull. U. S. Geol. Surv., No. 101, 18, pl. 2, fig. *h*, (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

20. ETOBLATTINA JEFFERSONIANA sp. nov.

Pl. V, fig. 7.

The only specimen of this species is a fragment from the middle half of the tegmina, with striking neuration; probably the tegmina were about two and a half times as long as broad, with both costal and inner margins gently convex, indicating a very regular oblong-obovate form. On this hypothesis, the mediastinal vein extended considerably beyond the middle of the tegmina, nearly to the distal end of the middle fifth, and was vittate, tolerably broad, with rather distant, parallel, straight, oblique branches. The scapular vein is extraordinarily distant from the mediastinal, strongly and regularly arcuate, and terminates probably short of the apical margin; it first forks just beyond the middle of the proximal half of the tegmina, and has about five inequidistant branches, which are long, arcuate, and simple or deeply, rarely doubly, forked, having the same trend as the mediastinal branches. The externomedian vein is broadly arcuate, first forks a little within the proximal two-fifths of the tegmina, and has about four longitudinal branches, the earlier ones compound and gently arcuate, the later ones simple or forked and nearly straight. The internomedian vein is broadly sinuate, the area being apically and very gradually attenuate, and probably reaching beyond the scapular area, with branches which are gently arcuate, simple, oblique, and become more and more longitudinal, about as distant as the mediastinal branches. The surface of the tegmina is uniformly carbonaceous, and there is no sign of any cross lines.

Length of fragment, 15 mm.; probable length of tegmina, 23.5 mm.; breadth, 9.5 mm.

This species bears some resemblance to the European *E. ornatissima*, but from the imperfection of the latter the scapular areas can not be compared; it seems, however, to have been in this direction wholly unlike our species. *E. jeffersoniana* also somewhat resembles our *E. gratiosa*, but differs entirely in the length and character of the mediastinal area and the peculiarities of the scapular venation.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, Nos. 186 and 184.

21. ETOBLATTINA RESIDUA sp. nov.

Pl. V, fig. 1.

A portion only of one of the tegmina is preserved in the only specimen of this species seen, lacking the entire costal margin, but the greater part of the neuration is preserved and shows a peculiar species. The tegmina are apparently about two and a half times longer than broad with a nearly straight inner margin; the costal margin was probably somewhat strongly arcuate and the apex subacuminate, the tegmina tapering from before the middle. A fragment only of the mediastinal vein is preserved, showing the area to have been remarkably narrow, terminating before the distal end of the middle fifth of the tegmina. The scapular vein is rather strongly sinuate, and terminates somewhat before the apex of the tegmina; it first forks before the tip of the anal furrow, hardly beyond the basal fifth of the tegmina, and probably has five or six simple or forked, long, straight, and remarkably longitudinal branches. The externomedian vein is similarly sinuate, first forks but little beyond the scapular and has but two branches, the second emitted near the middle of the tegmina, the branches doubly forked or compound, gently arcuate and longitudinal. The internomedian vein is strongly sinuate, apically very attenuate, but fails even to reach the apical margin; it has seven or more rather distant branches, the proximal nearly straight, the distal arcuate and longitudinally oblique. The anal furrow is strongly arcuate, scarcely impressed, terminating at the end of the basal fourth of the tegmina, so that the area is remarkably abbreviated. The surface is uniformly black and the interspaces traversed by rather crowded delicate cross lines.

Length of fragment, 11 mm.; probable length of tegmina, 15.5 mm.; breadth of fragment, 5.25 mm.; probable complete breadth, 6 mm.

This species seems to be most nearly, but not closely, allied to *E. jeffersoniana*, but differs from it in form, in the narrowness of the mediastinal, scapular, and apical portion of the internomedian areas, and in the totally different formation of the scapular mode of branching.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va.—Mr. R. D. Lacoe; one specimen, No. 2131*a*.

22. ETOBLATTINA FUNERARIA sp. nov.

Pl. V, fig. 5.

Tegmina oval, two and a half times as long as broad, the inner margin straight before the apex, the costal margin strongly and pretty regularly convex, the apex probably well rounded. The mediastinal area is vittate, rather narrow, almost two-thirds as long as the tegmina, with rather few, inequidistant, straight or arcuate, simple, strongly oblique branches. The scapular vein is nearly straight but feebly and very broadly sinuate, terminating at no great distance before the apex of the tegmina; it first forks at the end of the proximal third of the tegmina, and has five or six very oblique feebly arcuate branches, which are apically forked at a distance from the margin equal to the width of the mediastinal area. The externomedian vein, at first arcuate, is thereafter nearly straight, longitudinally oblique and apically faintly arcuate; it first forks just beyond the scapular vein, and in the middle of the tegmina has three longitudinally and gently arcuate forked or doubly forked branches. The internomedian vein is arcuate, very feebly except at base, and terminates long before the apex of the tegmina with five or six rather distant, simple, arcuate, oblique or longitudinally oblique branches. The anal furrow is strongly bent arcuate, strongly impressed, and terminates somewhat beyond the end of the proximal third of the tegmina; the anal veins are simple, at first distant and arcuate, then sinuate, then proximate and straight, in passing from the anal furrow. All the nervures, but especially those of the anal area, are strongly and rather broadly edged with black, giving the whole a funereal appearance, and in the anal and internomedian areas, and to a faint degree elsewhere, are distinct cross lines closely crowded and straight between the nervules.

Length of largest fragment, 14.5 mm.; probable length of tegmina, 17.5 mm.; breadth, 7 mm.

This species is of the type of *E. russoma* of Europe, from which it differs mainly in the characteristics of the scapular vein, and the small number of externomedian veinlets. It also resembles, in many points, some of our own species, such as *E. exsecuta*, from which it may be separated by its broader and less attenuated internomedian area, which feature, as well as the relatively greater breadth of the tegmina, separates it from *E. accubita* and *E. expulsata.*

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2108 *a–b*, *c*.

23. ETOBLATTINA EXPUNCTA sp. nov.

Pl. V, fig. 6.

Tegmina a little more than two and a half times longer than broad, ovate, with gently arcuate costal border, very gently arcuate inner border and probably well-rounded apical border. Mediastinal area vittate, apically attenuate, reaching slightly beyond the distal end of the middle third of the tegmina; the branches few, simple, straight, and longitudinally oblique. Scapular and externomedian veins apparently united in the proximal fourth of the tegmina, the scapular thereafter straight and terminating at the very apex; it first forks almost immediately after its freedom from the externomedian vein and before the middle of the tegmina, and has at least three longitudinally oblique gently arcuate branches, all arising before the middle of the distal half of the tegmina and all deeply forked, the first very deeply and doubly forked. The externomedian vein is bent at parting from the scapular and is thereafter straight and oblique, and has four or five subequidistant, straight, simple, longitudinal branches. Internomedian vein arcuate at base, beyond straight, terminating in the middle of the distal two-fifths of the tegmina, with numerous and crowded, mostly simple, straight, oblique branches. The anal furrow is concealed in the only specimen seen by the slipping forward of the partially detached anal area, but the vaulting of the latter indicates that it was deeply impressed, pretty strongly arcuate, and terminated at about the end of the proximal third of the tegmina; anal veins numerous, gently arcuate, mostly simple, but some deeply forked. The surface of the tegmina is uniformly black, apparently delicately shagreened and there is no trace of cross lines.

Length of fragment, 11 mm.; probable length of tegmina, 15 mm.; breadth, 5.75 mm.

The species is somewhat allied to *E. mucronata*, but has an altogether different mediastinal area, with no such tapering form of the tegmina. *E. debilis* has the same basal union of the scapular and externomedian veins, but that species has much broader tegmina and very different internomedian branches. *E. russoma* is its nearest European ally, but it is very different from that species at nearly every point.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2109 *a–b*.

24. ETOBLATTINA GORHAMI.

Pl. V, fig. 8.

Etoblattina gorhami Scudd., Bull. U. S. Geol. Surv., No. 101, 17-18, pl. 2, fig. *a* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

25. ETOBLATTINA APERTA sp. nov.

Pl. V, fig. 9.

Although only the middle half of one of the tegmina of the specimen on which this species is based is preserved, it retains nearly all the most characteristic features of the tegmina and is so remarkable that it can not be passed by. To judge by the margins preserved and by the course of the veins and their branches it had a tapering oval form, the tegmina considerably less than three times as long as broad, and probably tapering from near the middle of the proximal half apexward. The mediastinal vein appears on the fragment only by its tip, which reached but little beyond the middle of the tegmina, the branches very oblique. The scapular vein ran in a tolerably straight course not far above the middle line of the tegmina to a little beyond the center, when it curved strongly upward to the costal margin, which it struck not far from the proximal end of the distal fifth of the tegmina; it probably first forked not far beyond the proximal fourth of the tegmina and had four considerably arcuate, oblique, simple or more or less deeply forked branches. The externomedian vein is nearly straight, very distant from the scapular, and has in the fragment only a single but very important and singular branch, which, unless there is a slight branch to the main vein near the tip, takes all the divarication that appertains to the main stem, for, curving in the same sense as the main scapular vein and slightly approaching it, it throws off, subparallel to the main stem, three longitudinal and arcuate simple or forked branchlets. The internomedian vein, too, is peculiar; it lies at an extraordinary distance from the externomedian vein, and soon after its freedom from the anal area runs completely parallel to the inner margin and at no great distance from it, the area being in the middle less than a fourth of the width of the tegmina, and probably terminates on the apical margin, where it curves around to meet its straight course; the branches are simple, distant, strongly arcuate and longitudinally oblique. The main veins are heavily and broadly, the branches narrowly, margined with black, and there is very faint sign of crowded cross lining betwen the nervures.

Length of fragment, 9 mm.; probable length of tegmina, 16 mm.; breadth, 6 mm.

This species is most nearly allied to *E. fasciata*, but differs from it in the still narrower internomedian area and the totally different neuration of the externomedian vein. I formerly[1] regarded it as the same, but there can be little doubt of its distinctness.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2066 *a–b*.

26. ETOBLATTINA FASCIATA.

Pl. V, fig. 11.

Etoblattina fasciata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 47–48, 1889.

The second specimen described under this name in the above-mentioned paper (p. 48) was wrongly referred to this species and is here described as *E. aperta*, No. 25. No further specimens of the present species have been found.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County.

27. ETOBLATTINA RAMOSA sp. nov.

Pl. V, fig. 12.

The greater and nearly all the important part of one of the tegmina shows them to be of a lanceolate form, but with the costal far more strongly arcuate than the inner margin, with a probably strongly rounded somewhat pointed apex, the whole about two and a half times longer than broad. The mediastinal vein is straight and subparallel to the arcuate margin in the middle of its course, and roundly bent toward the margin at the origin of its last offshoot, ending scarcely beyond the middle of the tegmina; the branches are distant, gently arcuate, strongly oblique and apically narrowly forked. The scapular vein is nearly straight, but apically slightly arcuate, terminating a little below the apex of the tegmina; it first forks a little beyond the proximal fourth of the tegmina and has four or five branches, which are strongly or longitudinally oblique, more or less sinuous, and deeply and sometimes doubly forked. The externomedian vein is nearly straight, but apically slightly sinuous and first forks scarcely before the middle of the tegmina, and has three or four inequidistant longitudinal branches, all simple or forked only apically if at all, together occupying only the narrow apical margin. The internomedian vein, at first straight, is afterward sinuous, retreating from and then advancing toward the externomedian vein, so as to leave a widened space between these main veins, much after the fashion of Spiloblattina, and terminating a little below the extreme apex of the tegmina; its branches are distant, longitudinally oblique and arcuate, all or nearly all more or less deeply, often doubly, forked or ramose. The anal furrow strikes the margin at about the end of the proximal third of the tegmina. The surface is black but with long, uncolored, fusiform patches in the wider interspaces, while in the blackened portions it is delicately, feebly, and minutely reticulate, the reticulations partially giving way in the internomedian area to tremulous cross lines.

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[1] Proc. Bost. Soc. Nat. Hist., XXIV, 48.

Length of fragment, 16 mm.; probable length of tegmina, 25 mm.; breadth, 10 mm.

This species certainly bears a close general resemblance to *E. hastata* from the same beds, but has a much stouter form and more strongly sinuous internomedian vein, besides larger mediastinal and anal areas; the peculiarities of the branching of each vein is, however, very similar.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 108.

28. ETOBLATTINA WILLSIANA sp. nov.

Pl. V, fig. 13.

Tegmina lanceolate, tapering from the basal third, more than two and one-half times longer than broad, the costal margin rather strongly and pretty regularly arcuate, the inner margin scarcely arcuate, the apex subacuminate and strongly rounded. Mediastinal area long triangular, the vein very straight and terminating scarcely beyond the middle of the tegmina, the proximal branches transversely oblique and straight, the distal oblique or very oblique and arcuate, all simple. Scapular vein broadly sinuate by the bending of the vein at the origin of the first two branches and its apical slight arcuation, terminating well before the apex of the tegmina; it has about half a dozen very oblique branches, the first branch arising near the middle of the proximal half of the tegmina and nearly continuing the basal course of the main vein; the distal branches are simple, the others deeply forked, doubly forked, or compound. The externomedian vein is gently sinuous, terminating below the apex of the tegmina, so that its branches occupy symmetrically the narrow apex; it has three distant longitudinal branches, the lower ones simple, the first, arising well before the middle of the tegmina, simple halfway to the tip, and then nearly opposite the second branch it is narrowly arborescent; it parts so narrowly from the main stem that the vein appears to have two narrowly divergent, unequal, forking branches. The internomedian vein is strongly sinuate, though straight in the middle of its course, and terminates as near the apex as the scapular vein; its branches are rather distant, all but the apical and some of the proximal forked or doubly forked, the proximal oblique and gently arcuate, the distal longitudinally oblique and arcuate. The anal furrow can not strike the inner margin far beyond the proximal third of the tegmina, but this portion is lost in the single specimen seen. The surface is carbonaceous black, with a loss of color in elongate patches in the interspaces, and the black portions are delicately and irregularly reticulate.

Length of fragment, 22.5 mm.; probable length of tegmina, 26.75 mm.; breadth, 10.25 mm.

This species is very closely allied to *E. ramosa*, but is distinguishable from it by the straightness of the mediastinal vein, the angularity of the scapular and the earlier forking and different mode of branching of the externomedian vein. Almost similar differences separate it from the straight veined *E. funesta*. In the peculiar formation of the externomedian area it bears some resemblance to the European *E. elongata*.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 176.

29. ETOBLATTINA LESQUEREUXII.

Etoblattina lesquereuxii Scudd., Mem. Bost. Soc. Nat. Hist., III, 67–69, fig., pl. 6, figs. 2, 3 (1879); Foss. Ins. N. A., I, 87–89, fig., pl. 6, figs. 3, 4 (1890).

From the roof shales of the D seam of anthracite at Yatesville, near Pittston, Pa.

30. ETOBLATTINA MALEDICTA sp. nov.

Pl. VI, figs. 1–3.

Tegmina oblong ovate, two and one-half or more times longer than broad, the costal margin broadly arcuate, the inner margin mostly straight, the apex well rounded. Mediastinal area rather narrow, vittate, the tip acuminate, ending distinctly beyond the middle of the tegmina; the branches moderately numerous, rarely forked, ve oblique, gently arcuate. Scapular vein broadly sinuate, ending a ve little before the apex, first forking somewhat beyond the proxim fourth of the tegmina, with about five inequidistant branches, whi are mostly deeply forked or doubly forked, arcuate, and longitudina oblique, the first generally arising far before the others. Externo dian vein beyond the strong basal arcuation very broadly sinua first forking at about the middle of the tegmina, with three simple forked branches, all nearly longitudinal, occupying at tip the apic margin only of the tegmina. Internomedian vein broadly sinuate (i is drawn too straight in fig. 2), terminating almost or quite as near the apex as the scapular vein, its branches not very numerous, arcuate and oblique, mostly simple, but occasionally deeply forked. Anal furrow rather strongly arcuate, delicately impressed, terminating at the end of the proximal two-fifths of the tegmina; anal veins simple, next the anal furrow strongly arcuate, beyond sinuate and more crowded. Surface of the tegmina carbonaceous black, with more or less fusiform brown patches in the interspaces, the black portions marked with crowded, more or less tremulous and irregular cross lines.

Length of largest fragment, 23 mm.; probable length of tegmina, 25 to 29 mm.; breadth, 9.5 to 11 mm.

This species is closely allied to *E. variegata* and *E. stipata*, but is of a stouter form, with the main veins more curved than in the former, and with less abundantly branched scapular and externomedian veins than in the latter. One of the specimens (No. 165) differs from the others in that the first branch of the scapular vein is compound and carries a much larger share than usual of the scapular system, much as in No. 163 (fig. 2), but in a still more aggressive manner.

Lower Barren Coal-measures of Ohio, less than 100 feet above th crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferso County. Mr. S. Huston; seven specimens, Nos. 163, 164, 165, 170, 17 181, 192.

31. ETOBLATTINA BENEDICTA sp. nov.

Pl. V, figs. 14, 15.

Tegmina about two and one-half times longer than broad, taperin from the end of the basal third, the costal margin very strongly arcu ate, the inner margin nearly straight except at the extremities, the ape subacuminate but well rounded. Mediastinal area vittate, taperin only close to the tip, which reaches about to the distal end of th middle fifth of the tegmina; the branches rarely forked, slightly arcu ate, and very oblique. The scapular vein is considerably sinuate an terminates well before the apex of the tegmina; it first forks a litt beyond the basal third of the tegmina and has five or six branches, which the first two arise close together; the branches are mostly forke or compound, most of them considerably arcuate and very oblique indeed. The externomedian vein beyond its strong basal arcuation is nearly straight, but feebly arcuate in an opposite sense; it first forks near the middle of the tegmina and has three branches which are longitudinal, nearly straight, and in the apical fourth of the tegmina forked or compound. Internomedian vein strongly sinuate, much more strongly arcuate at base than apically, the area being apically attenuate and yet terminating far before the apex of the tegmina; the distant branches are more or less arcuate, simple or apically forked and oblique. The anal furrow is strongly arcuate, scarcely impressed, and terminates before the end of the proximal third of the tegmina; the anal veins are in no instance preserved. The surface is precisely as in *E. maledicta.*

Length of large fragments, 16 to 22 mm.; probable length of tegmina, 23.5 to 24 mm.; breadth, 9 to 10 mm.

This species is very closely allied to *E. maledicta*, and will possibly be found to be identical with it; it differs principally in the much stronger arcuation of the costal border, the briefer extension of the internomedian area, and the approximation at base of the first two branches of the scapular vein. It seems to be equally abundant with *E. maledicta*, and is with it the most common of the Richmond species. The different specimens agree remarkably in the neuration of the scapular area, the greatest difference being shown in the two selected for illustration.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; six specimens, Nos. 166 and 167, 168, 178, 179 and 191, 183 and 193, 199.

32. ETOBLATTINA FUNESTA sp. nov.

Pl. VI, fig. 4.

Tegmina nearly three times as long as broad, lanceolate, tapering apically from the middle, with broadly arcuate costal margin and feebly arcuate inner margin, the apex strongly rounded. Mediastinal area moderately broad, tapering, terminating at about the distal end of the middle fifth of the tegmina, with strongly oblique, rather distant and straight, simple or forked branches. Scapular vein exceedingly straight in more than its middle half, broadly arcuate apically, and ending just before the narrow apical margin; it first forks at about the end of the proximal fourth of the tegmina, and has half a dozen straight or sinuate, strongly oblique or longitudinally oblique branches, most of them forked, and sometimes compound. The externomedian vein beyond the base is rigidly straight, scarcely bent where first forked, and has but a couple of approximate branches, occasionally three, thrown off at the middle of the tegmina and beyond, both branches straight and longitudinal, soon and almost simultaneously forked and probably again forked beyond. In contrast to these the internomedian vein is strongly sinuate (though nearly straight in its middle course), leaving a wide space between it and the externomedian vein, and terminates somewhat earlier than the scapular vein; its branches are not crowded, simple, or forked, mostly the former, gently arcuate and oblique. The anal furrow terminates short of the end of the proximal two-fifths of the tegmina. The surface of the tegmina is carbonaceous black, with large, elongate, pale patches in the larger interspaces, and there is feeble sign in a few places of delicate, not very crowded, cross lining.

Length of best fragment, 20 mm.; probable length of tegmina, 27 mm.; breadth, 9.5 mm.

The species is nearly allied to *E. tenuis*, from which it differs mainly in the later and different branching of the externomedian vein and the much more strongly sinuate course of the internomedian. It is a much slenderer species than the preceding, from which it differs in the straightness of the middle veins and in its slenderer form. There is a somewhat striking difference between two of the specimens in the straightness or sinuation of the scapular branches, and especially in the proximal.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Three specimens: Mr. S. Huston, Nos. 107 and 177, 180; United States Geological Survey, No. 2186.

33. ETOBLATTINA EXSENSA sp. nov.

Pl. VI, figs. 7, 8.

Tegmina slender and lanceolate, about two and one-half times longer than broad, to judge from the fragments preserved, which only show the central portions; the costal margin gently arcuate and the inner nearly straight. Mediastinal area vittate, tapering in its apical half, acuminate, reaching to about the distal end of the middle fifth of the tegmina, the veins very oblique, simple, and straight. Scapular vein faintly arcuate, terminating slightly before the extreme apex of the tegmina, first forking only a little before the proximal fourth of the tegmina, the first branch nearly longitudinal, and bearing most of the branchlets, which are similar to those of the mediastinal vein, but distinctly less oblique; the main vein forks again several times, the first at about the middle of the tegmina, the branches longitudinally oblique and forked (very likely compound). Externomedian vein nearly straight to about the middle of the tegmina, and then bent at the first fork, following a longitudinally oblique course toward the inner margin; it has two or more forked and, perhaps, compound branches. The internomedian vein is strongly sinuous, being straight and longitudinally oblique beyond the basal arcuation to near the middle of the tegmina, thereafter parallel or subparallel to the inner margin, and doubtless curving down toward it apically; its distant branches have a varying obliquity and are arcuate, and, at least beyond the basal ones, mostly forked or doubly forked. The anal furrow probably terminates at about the end of the proximal third of the tegmina. The surface is black, with broader or narrower elongate brown patches in the interspaces, sometimes reducing the black to a narrow bordering to the nervures, though never closely approaching the margin of the tegmina; over the black portions can be seen a delicate, close, and tremulous cross lining.

Length of fragments, 9 to 11 mm.; probable length of tegmina, 25 to 27.5 mm.; breadth, 10.5 to 11 mm.

This species closely resembles *E. tenuis*, from which it differs principally in the great importance of the first scapular branch. It is similarly distinguished from the two preceding species.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; two specimens, Nos. 161, 196.

34. ETOBLATTINA TENUIS.

Pl. VI, fig. 6.

Etoblattina tenuis Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 46–47 (1889).

This is the only one of our species with open and widely separated neuration in the center of the tegmina which bears any very close resemblance to the single European species of that type, *E. elongata* (Gein.), from the Dyas, and it is very distinct from that.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County.

35. ETOBLATTINA HUSTONI.

Pl. VI, fig. 9.

Etoblattina hustoni Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 53 (1889).

From the same place as the last mentioned.

36. ETOBLATTINA PERSISTENS.

Etoblattina persistens Scudd., Mem. Bost. Soc. Nat. Hist., IV, 459–460, pl. 41, fig. 7; pl. 42, figs. 10,[1] 19 (1890); Foss. Ins. N. A., I, 435–436, pl. 33, fig. 7, pl. 34 figs. 10,[1] 19 (1890).

This and an imperfect fragment of another and unnamed species are the only post-Paleozoic Etoblattinæ known.

Trias of Fair Play, Colo.

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[1] A most unfortunate error occurs in one of the plates of my paper on the "Triassic insects of Fair Play" (pl. 42 of the Memoirs of the Boston Society of Natural History, vol. 4; pl. 34 of my Fossil Insects of North America, vol. 1), caused by a rearrangement of the plate after the text was prepared without a corresponding change in the text; accordingly, the following changes should be made in the numbers attached to the figures on this plate: Fig. 9 should be numbered 13; fig. 10. 9; fig. 12, 10; fig. 13, 17; fig. 15. 12; fig. 16, 15; and fig. 17 should be numbered 16. The text and plate will then correspond.

37. ETOBLATTINA EAKINIANA sp. nov.

Pl. VII, fig. 1.

Tegmina subovate, less than two and one-half times longer than broad, the costal margin strongly shouldered and beyond that gently and regularly arcuate, the inner margin straight, the apex probably well rounded. Mediastinal area vittate, tapering through almost the distal half, reaching to the distal end of the middle fifth of the tegmina, the branches of the vein rather close, mostly simple, increasingly oblique. Scapular vein broadly arcuate, terminating at less than halfway from the tip of the mediastinal vein to the apex of the tegmina, with two very longitudinally oblique, simple, arcuate branches arising about opposite the end of the anal furrow. Externomedian vein gracefully and uniformally sinuate, of far more importance than the scapular, first forking before the end of the proximal fourth of the tegmina, the first branch forking near the origin of the second branch, each fork again dividing halfway to the margin; the other three branches arise near together near the middle of the tegmina, and are simple or forked, all the branches arcuate, less so from above downward, and all nearly longitudinal. Internomedian vein sinuate like the preceding, terminating but little below the apex, the simple branches not crowded as in the two previous areas, slightly arcuate, oblique, and increasingly so in the distal half of the area. Anal furrow strongly and regularly arcuate, strongly impressed, terminating at the end of the proximal third of the tegmina; anal veins arcuate, simple, not numerous. The surface of the tegmina is uniformly black, with faint traces of exceedingly close cross lining in the internomedian area.

Length of fragment, 13 mm.; probable length of tegmina, 15.25 mm.; breadth, 6.5.

The characteristics of the scapular vein easily separate this from other species in the vicinity. It is named for Mr. C. L. Eakin, of Wadestown, W. Va., who has done good service in the exploitation of the locality at Cassville, which has yielded so many remains of Etoblattina.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2111 *a–b*.

38. ETOBLATTINA ACCUBITA sp. nov.

Pl. VII, fig. 2.

Tegmina nearly three times as long as broad, tapering from the middle in each direction, but more sharply toward the base than toward the apex, the costal margin being very strongly and rather regularly arcuate, the inner margin nearly straight, and the apex probably well rounded. Mediastinal area vittate, terminating at the distal end of the middle fifth of the tegmina, the vein with few mostly simple, nearly straight, strongly oblique branches. Scapular vein feebly arcuate beyond the basal sinuation, ending well before the apex of the tegmina, with three subequidistant, deeply forked or simple, longitudinally oblique branches, the middle one arising at the middle of the tegmina. Externomedian vein gracefully and rather strongly sinuate, with four mostly simple, slightly arcuate, longitudinal branches, the first arising scarcely later than the first scapular branch. Internomedian vein similarly arcuate, terminating slightly below the apex of the tegmina, the rather numerous branches mostly simple, very oblique, and feebly arcuate, the apical ones longitudinally oblique. Anal furrow less strongly arcuate than usual, terminating but little short of the middle of the tegmina; anal area destroyed in the only specimen seen. The surface is uniformly black, and there is everywhere the feeblest possible sign of close cross lining in the interspaces.

Length of fragment, 12 mm.; probable length of tegmina, 14.75 mm.; breadth, 5.25 mm.

The species is peculiar for the basal narrowing of the tegmina and the apparent length and slenderness of the anal area. It is not distantly related to *E. mazona* and other species, but differs at almost every point.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2112*a*.

39. ETOBLATTINA MAZONA.

Pl. VI, fig. 5. (See also fig. 3 on p. 31.)

Etoblattina mazona Scudd., Mem. Bost. Soc. Nat. Hist., III, 181, pl. 10 (1882); Proc. Bost. Soc. Nat. Hist., XXI, 392-396 (1882); Foss. Ins. N. A., I, 233, pl. 7*a* (1890).

From the Lowest Productive Coal-measures at Mazon Creek, Illinois.

40. ETOBLATTINA EXPULSATA sp. nov.

Pl. VII, figs. 3, 4.

Tegmina lanceolate, nearly three times as long as broad, tapering from the middle of the proximal half, the costal margin strongly arcuate, especially basally, the inner margin straight, the apex well rounded. Mediastinal area vittate, apically very attenuate, reaching the distal end of the middle third of the tegmina, the branches of the vein rather numerous, nearly straight, simple and very oblique, the apical longitudinally oblique. Scapular vein uniformly and rather strongly sinuate, ending a little before the apex, first forking at or a little beyond the end of the proximal third of the tegmina, the branches, five or six in number, mostly simple, feebly arcuate or sinuate, longitudinally oblique. Externomedian vein sinuate, more strongly arcuate at base than at apex, first forking just beyond the first scapular fork, with three longitudinal forked or doubly forked branches. Internomedian vein strongly sinuate, the area extended nearly to the tip by its apical prolongation through a superior subramose offshoot from a little beyond the middle of the tegmina, the other branches mostly simple, arcuate, oblique, and more distant than the branches of other veins. Anal furrow strongly bent-arcuate, strongly impressed, and terminating a little beyond the end of the proximal third of the tegmina; anal area gently vaulted, the veins simple, strongly arcuate. The surface of the tegmina is blackish-brown, and the veins are marked and sometimes narrowly edged with black, while all the interspaces are traversed by very close straight or sinuate cross lines.

Length of one fragment, 14.5 mm.; probable length of tegmina, 16 mm.; breadth, 6 mm. Length of another fragment, 18.5 mm.; probable length of tegmina, 20 mm.; breadth, 7 mm.

This species is very closely allied to the next four or five species, but is sufficiently distinct from them all in the peculiar formation of the apical part of the internomedian area. The two principal specimens referred to here (and figured) differ a little in size and in the point of origin of the first scapular branch.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; three specimens, Nos. 2113 *a–b*, *c–d*, *e–f*.

41. ETOBLATTINA GRATIOSA sp. nov.

Pl. VII, fig. 5.

Tegmina ovate, somewhat less than three times as long as broad, the costal margin strongly arcuate throughout, the inner margin straight, the apex well rounded. Mediastinal area vittate, apically very attenuate, reaching fully to the distal end of the middle third of the tegmina, the branches of the vein simple, nearly straight, exceedingly oblique. Scapular vein gracefully, pretty uniformly and rather gently sinuate, subparallel to the inner margin, ending somewhat before the apex; it first branches a little beyond the proximal fourth of the tegmina, and has about five branches which have a longitudinal sweep and are mostly simply deeply and narrowly forked. The externomedian vein is strongly arcuate at the base, feebly sinuate, nearly straight in the middle and gently arcuate apically, first branching just beyond the scapular vein, and with four longitudinal, nearly straight, mostly forked branches, the forks of varying depths. Internomedian vein feebly sinuate, apically arcuate with no sign of special extension, yet terminating nearly as far out as the scapular vein; its branches are more distant than those of the other areas, simple or deeply forked, oblique and nearly straight. Anal furrow strongly bent-arcuate, deeply impressed except apically, terminating a little beyond the proximal third of the tegmina; anal veins strongly arcuate, simple or profoundly forked. The surface of the tegmina is uniformly blackish, and the interspaces are filled with crowded, straight, delicate cross lines.

Length of fragment, 16.5 mm.; probable length of tegmina, 18.25 mm.; breadth, 6.75 mm.

This species is closely allied to *E. expulsata* and has many of its special peculiarities, such as the strongly arcuate costa and the separation of the oblique internomedian veins, as well as the general distribution of the branches; but it differs from it distinctly in the structure of the extremity of the externomedian area. It also bears a close general resemblance to *E. exsecuta*, especially in the mediastinal, scapular and anal areas, but it differs from it at almost every other point. It bears also a general resemblance to the European *E. didyma*, but differs in almost every detail.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2114 *a–b*.

42. ETOBLATTINA MACERATA sp. nov.

Pl. VII, fig. 6.

Tegmina two and three-quarters times longer than broad, ovate, tapering from the middle of the proximal half, the costal margin rather strongly arcuate, especially in the proximal half, the inner margin straight, the apex well rounded. Mediastinal area vittate, apically attenuate, reaching the distal end of the middle third of the tegmina, the vein with few and rather distant, nearly straight, very oblique branches. Scapular vein broadly sinuate, terminating a little above the apex, first forking a little beyond the proximal third of the tegmina, the branches entirely similar to those of the mediastinal area, except in their greater length. Externomedian vein strongly sinuate, with four inequidistant, longitudinal, sinuate branches, simple or deeply forked, the first arising a little beyond the first scapular fork. Internomedian vein sinuate, terminating long before the apex of the tegmina, with branches about as distant as those of the mediastinal area, the proximal ones simple, gently sinuate and oblique, the distal mostly deeply forked, arcuate, and very oblique. Anal furrow strongly arched, deeply impressed, terminating scarcely short of the end of the proximal two-fifths of the tegmina; anal veins simple, strongly arcuate, distant. Surface very dark, all the veins edged narrowly, the anal veins broadly, with black, which is traversed by closely crowded straight cross veins.

Length of tegmina, 19.5 mm.; breadth, 7 mm.

This species is very closely allied to several others; the relative sparseness and simplicity of the scapular and mediastinal branches separate it from *E. expulsata* and *E. gratiosa*, and the lesser length of the mediastinal area from *E. immolata*; in the similarly early origin of the first branch of the scapular and externomedian veins it is distinct from *E. communis*, while the same characteristic and the greater stoutness of the tegmina distinguish it from *E. obatra* and *E. secreta*; from *E. obatra* it is still further separated by its simpler neuration.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2081 *a–b*, *c*.?

43. ETOBLATTINA IMMOLATA sp. nov.

Pl. VII, figs. 7, 8.

Tegmina somewhat more than two and a half times longer than broad, ovate, tapering from about the middle, with rather strongly arcuate costal margin (more strongly arcuate in some than in others), nearly straight inner margin and probably a well-rounded apex. Mediastinal area vittate, tapering only at extreme apex, reaching nearly to the middle of the distal half of the tegmina, the vein with simple, rarely forked, strongly oblique, nearly straight, rather abundant branches. Scapular vein more or less strongly sinuate, terminating somewhat short of the apex of the tegmina, first forking a little before a point opposite the tip of the anal furrow, with four or five simple or deeply forked, more or less arcuate, longitudinally oblique branches. Externomedian vein rather strongly sinuate, first forking scarcely beyond the scapular vein, with about four longitudinally arcuate, simple or perhaps apically forked branches. Internomedian vein gracefully and rather gently sinuate, terminating a little short of the apex of the tegmina, with six or eight arcuate, generally simple, very oblique branches. Anal furrow strongly arcuate, deeply impressed, terminating at just about the end of the proximal two-fifths of the tegmina; anal area gently vaulted, the veins rather numerous, strongly arcuate next the anal furrow, nearly straight in the opposite region. Surface exactly as in *E. macerata.*

Length of largest fragment, 14 mm.; probable length of tegmina, 17.75 mm.; breadth, 6.5 to 7 mm.

This species is closely allied to the three preceding species, but is sufficiently distinguished from them by the greater length of the mediastinal area, in which it approaches the genus Gerablattina. From the two following species, to which it is also very closely allied, it differs in the nearly simultaneous origin of the first branches of the scapular and externomedian veins.

The two specimens placed here differ rather unusually at one or two points, especially the arcuation of the costal margin, the breadth of the mediastinal area, and the number of internomedian branches.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, Nos. 2115 *a–b*, *c–d*.

44. ETOBLATTINA MACTATA sp. nov.

Pl. VII, fig. 9.

Tegmina two and three-quarters times longer than broad, ovate, the costal margin very regularly and gently arcuate, the inner margin nearly as arcuate, the apex doubtless strongly rounded. Mediastinal area vittate, tapering only beyond the middle of the tegmina, reaching almost to the middle of their distal half, the vein with moderately numerous, mostly simple, very oblique, straight branches. *Scapular* vein rather strongly sinuate, terminating a very little before the extreme apex of the tegmina, first branching at the end of the proximal third of the tegmina, with four or five subequidistant, arcuate, simple or forked branches, which apically have the same direction as the distal mediastinal branches. Externomedian vein strongly arcuate, first branching considerably later than the scapular vein, with three simple or deeply forked (probably reforked apically), nearly longitudinal but arcuate branches, occupying on the margin only the narrow apex of the tegmina. Internomedian vein strongly and very gracefully arcuate, terminating as near the apex as the scapular vein, with five deeply forked or simple branches, the proximal ones nearly straight and oblique, the distal arcuate and longitudinally oblique. Anal furrow very strongly arcuate except apically, sharply incised, terminating at about the end of the proximal two-fifths of the tegmina; anal area slightly vaulted, the veins gently or (toward the furrow) strongly arcuate, simple. Surface blackish brown, all the veins marked in black and perhaps delicately edged with the same, the interspaces with closely crowded straight cross lines.

Length of fragment, 15 mm.; probable length of tegmina, 18.5 mm.; breadth, 7.25 mm.

This species is separated from those which immediately precede it, and to which it is closely allied, by the relatively wide intervals between the origin of the first scapular and externomedian branches. It is still more closely related to *E. communis*, from which the greater length of the mediastinal area clearly separates it. One can not but be struck, also, by the rather strong general resemblance this insect bears to *Gerablattina concinna* from the same beds, but besides the generic distinctions between them (which are here indeed feeble), it differs in almost every detail as well as in the form of the tegmina. Of the European species it is most nearly allied to *E. dohrnii*, but not at all closely.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2116*a*.

45. ETOBLATTINA COMMUNIS sp. nov.

Pl. VII, figs. 10–17.

Tegmina ovate, somewhat more than two and a half times longer than broad, the costal margin gently and pretty regularly arcuate, the inner margin faintly arcuate, the apex strongly rounded. Mediastinal area vittate, apically acuminate, reaching nearly, sometimes quite, to the distal end of the middle third of the tegmina, the vein with relatively few, mostly simple, and nearly or quite straight, very oblique branches. Scapular vein faintly broadly sinuate, terminating shortly before the very apex of the tegmina, first forking at about the end of the proximal fourth of the wing, often a little after, rarely before it, the branches three to five in number, the first generally widely separated from the second, mostly deeply forked, rarely doubly forked, but always some of them simple, and all longitudinally oblique and arcuate. Externomedian vein broadly sometimes strongly arcuate, rarely uniform, first forking some distance later than the scapular, the branches from two to four, usually four, in number, longitudinal, more or less arcuate, some of them simple, others deeply but narrowly forked, often doubly forked or even compound. The internomedian vein is gracefully sinuate, more strongly arcuate basally than apically, and ends not far from the apex but generally farther than the scapular vein; the branches are more distant than in the other areas and most of them are simple and very oblique, the distal more oblique than the proximal, but the first and some of the last are often deeply forked, and occasionally the area is apically filled by simple oblique branchlets from a longitudinally oblique preapical branch. Anal furrow strongly arcuate, impressed, terminating at a little beyond the proximal third of the tegmina; anal area gently vaulted, the veins simple and arcuate, not crowded. Surface blackish brown, all the veins marked and narrowly margined with black and the interspaces filled with crowded straight cross lines.

Length of tegmina, 16 to 21 mm.; breadth, 6 to 8 mm.

The species is sufficiently distinguished from *E. mactata*, its nearest ally, by the briefer extent of the mediastinal area; and from the four preceding species, to which it is also closely related, by the wider separation of the points of origin of the first scapular and externomedian branches. It differs in the same feature, as also in the length of the mediastinal area, from *Gerablattina uniformis*, to which its general resemblance is very striking. It appears to be the commonest species in West Virginia, where ten specimens have been found.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, Nos. 2187 *a–b*, *c–d*, *e*, *f*, *g*, *h*, *i*, *j*, *k–l*, *m–n*.

46. ETOBLATTINA sp.

Etoblattina sp. Scudd., Mem. Bost. Soc. Nat. Hist., IV, 460, pl. 42, fig. 20 (1890); Foss. Ins. N. A., I, 436, pl. 34, fig. 20 (1890).

Triassic of Fair Play, Colo.

47. ETOBLATTINA HASTATA sp. nov.

Pl. VIII, fig. 1.

Tegmina lanceolate, tapering from a little beyond the middle of the proximal half, almost three times as long as broad, the costal margin very gently arcuate except at base and tip, where it is more strongly curved, the inner margin scarcely arcuate, the apex probably sharply rounded. Mediastinal vein straight until past the final branch, and then bent toward the margin, which it strikes before the middle of the tegmina, with rather distant, simple or narrowly forked, arcuate, very oblique branches. Scapular vein straight, terminating scarcely above the very apex of the tegmina, first branching before the end of the proximal fourth of the tegmina, the branches not numerous, inequidistant, longitudinally oblique, irregular and deeply forked, sometimes compound. Externomedian vein also straight, nearly parallel to the scapular throughout its course, first forking far beyond the scapular at about the end of the proximal two-fifths of the tegmina, the few branches nearly longitudinal, inequidistant, and, so far as preserved, simple. Internomedian vein irregularly sinuate, falling not far short of the apex of the tegmina, in the distal half of its course subparallel to the inner margin, the branches distant, inequidistant, mostly deeply forked or compound, some simple, arcuate and very oblique. Anal furrow terminating before the end of the proximal third of the tegmina. Surface uniformly carbonaceous, covered with a delicate tremulous reticulation.

Length of fragment, 17 mm.; probable length of tegmina, 27.25 mm.; breadth, 9.5 mm.

This species is evidently not distantly related to the apparently stouter species, *E. fasciata*, but has a very different internomedian area.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, No. 106.

48. ETOBLATTINA MARGINATA.

Pl. VIII, fig. 2.

Etoblattina marginata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 48-50 (1889).

From the same locality and horizon as the last.

49. ETOBLATTINA GRACILENTA sp. nov.

Pl. VIII, figs. 6, 7.

Tegmina almost exactly three times as long as broad, obovate, tapering but very little from about the end of the proximal third, the costal margin very strongly arcuate at base, beyond nearly straight to the rounded tip, the inner margin similarly straight, the apex rather broadly rounded. Mediastinal area narrow, vittate, but the feebly sinuate vein constantly approaching the margin in the apical half, reaching considerably beyond the proximal half of the tegmina, the branches of the vein not numerous, mostly deeply and narrowly forked, very strongly oblique. Scapular vein sinuate, much more strongly arcuate at base than beyond, where it is subparallel to the costal margin, with a varying but considerable number of inequidistant, longitudinally oblique branches, some of them arcuate, rarely simple, generally deeply forked, doubly forked or even compound, the first arising somewhat before the end of the proximal third of the tegmina. The externomedian vein, pretty strongly arcuate at the base, is thereafter nearly straight and subparallel to the scapular vein, but gradually parts slightly from it in the distal half of the tegmina; it first forks a little before the middle of the tegmina and has but three or four deeply and narrowly forked or compound longitudinal branches. The internomedian vein, after the basal arcuation, runs in a straight longitudinally oblique course to a little beyond the middle of the tegmina, when it curves so as to run a short distance parallel to the inner margin and then curves down to it, ending somewhat before the apex; most of its inequidistant branches are broadly and deeply forked and are increasingly oblique. Anal furrow sharply and deeply impressed, strongly arcuate and terminating slightly within the proximal two-fifths of the tegmina; the anal area is vaulted, the veins few, inequidistant, simple, those next the furrow bent-arcuate and distant, the others close and sinuate. Surface carbonaceous with feeble signs of cross lining in the interspaces.

Length of largest fragment, 28 mm.; probable length of tegmina, 28 to 29.5 mm.; breadth, 9 to 9.75 mm.

This species is easily distinguished from both *E. hastata* and *E. marginata* by the sinuation of the main veins, and from at least the former by its very different form. In its larger features the neuration resembles that of *E. willsiana*, but it is abundantly distinct from that species in every detail.

The two specimens figured differ somewhat and particularly in the length of the internomedian area, the apical space given to the externomedian area, and the proximal branches of the scapular area, which in one are more numerous and simpler than in the other.

Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; three specimens, Nos. 114, 198, and perhaps 105.

50. ETOBLATTINA EXSECUTA sp. nov.

Pl. VIII, fig. 4.

Tegmina long oval, almost three times as long as broad, tapering only from the middle, the costal margin strongly and very uniformly arcuate, the inner margin feebly arcuate, the apex pretty well rounded. Mediastinal area vittate, rather narrow, apically acuminate, terminating just before the end of the middle third of the tegmina, the branches of the vein rather few, straight, simple, and strongly oblique. Scapular vein gracefully and regularly sinuate, ending well before the apex of the tegmina, first forking just before the proximal fourth of the tegmina, with about four arcuate branches having the same trend as the mediastinal branches, simple or deeply forked. Externomedian vein strongly sinuate, more arcuate basally than apically, first forking but little beyond the scapular, with five or six sinuate, longitudinal, simple or apically and narrowly forked branches, or with only two or three of such branches, one of them compound. Internomedian vein sinuate like the externomedian, terminating not very far short of the apex of the tegmina, with half a dozen branches, less crowded than those of the scapular and externomedian veins, arcuate and oblique, simple or deeply forked. Anal furrow strongly bent-arcuate, sharply impressed, terminating at the end of the proximal two-fifths of the tegmina, the anal veins simple, numerous, more distant, and strongly arcuate next, more crowded and straight or sinuate away from, the furrow. Surface uniformly blackish brown, with closely crowded, straight cross lines in all the interspaces.

Length of tegmina, 18.75 mm.; breadth, 6.5 mm.

This species is very closely related to *E. communis*, from which it differs in the stronger arcuation of the costal margin, its slenderer form, and the closer approximation of the first fork of the scapular and externomedian veins. It differs similarly from *E. macerata* except in the last-mentioned point, and that the scapular and externomedian branches are more crowded. It also bears a nearly similar relation to the still slenderer *E. secreta*, but it has a shorter mediastinal area and a less elongated anal area. From *E. expulsata*, to which it is also closely allied, it differs in its slenderer form, the much less arcuate costal margin, and the earlier forking of the scapular and externomedian veins.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; three specimens. Nos. 2120 *a–b*, *c–d*, *e*, besides two others probably belonging here.

51. ETOBLATTINA ARCTA sp. nov.

Pl. VIII, fig. 5.

Tegmina exceptionally long and slender, more than three and a half times longer than broad, about equally slender at both extremities, the costal margin more arcuate at base than next apex, nearly straight in the middle, the inner margin feebly arcuate at base, nearly straight beyond to the sloping tip, the apex subacuminate, very sharply rounded. Mediastinal area vittate, broad, tapering only at extreme tip, which reaches but little beyond the middle of the tegmina, the branches of the vein distant, simple, straight, oblique. Scapular vein broadly arcuate, in most of its course parallel to the costal margin, terminating at about the middle of the distal third of the tegmina, first forking scarcely before the middle of the tegmina, its branches wholly similar to the mediastinal. Externomedian vein strongly sinuate, first forking at the end of the proximal third of the tegmina, the branches longitudinally sinuate, very few in number but mostly deeply forked or compound. Internomedian vein gently and broadly sinuate, terminating not far below the apex of the tegmina, in its apical third subparallel to the margin, its five or six branches simple or forked, exceedingly oblique or longitudinally oblique. Anal furrow with exceptionally slight and regular arcuation, impressed very sharply and very deeply indeed, terminating before the end of the proximal two-fifths of the tegmina; anal area exceptionally slender for its length, the veins few, simple and arcuate. Surface uniformly black, with signs of very feeble and close, often oblique, cross lining in the interspaces.

Length of tegmina, 18 mm.; breadth, 5 mm.

By its elongate straight form this species is very different from every other known, and it is hardly less remarkable for the imitation of the mediastinal by the scapular vein and the late forking of the latter.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2118*a*.

52. ETOBLATTINA STIPATA.

Pl. VIII, fig. 3.

Etoblattina stipata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 52–53 (1889).

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County.

53. ETOBLATTINA PRÆDULCIS sp. nov.

Pl. VIII, fig. 12.

Tegmina lanceolate, three times as long as broad, tapering from the end of the proximal third almost as much on the inner as on the costal side, the costal margin gently and regularly arcuate, the inner nearly as much so, the apex very sharply rounded. Mediastinal area broad, tapering in nearly the distal half, terminating somewhat before the distal end of the middle third of the tegmina, the branches very oblique, nearly straight, simple or forked. Scapular vein very faintly arcuate beyond the base, terminating a little before the very apex of the tegmina, first forking at the end of the proximal third of the tegmina, with about five simple or forked, straight and long, very oblique branches. Externomedian vein feebly oblique and nearly straight beyond the base, with three longitudinal branches very distant in origin, the first arising before the first scapular fork and in the single specimen seen simple, the second arising near the middle of the tegmina and narrowly forked, the third doubly and very deeply forked. The internomedian vein is gently sinuate, though nearly straight beyond the basal arcuation, ending well before the apex of the tegmina with half a dozen moderately close, mostly simple, feebly arcuate, strongly oblique branches. Anal furrow regularly and rather strongly arcuate, moderately impressed, terminating a little beyond the end of the proximal two-fifths of the tegmina; anal veins simple, arcuate. Surface of tegmina dark brown, *at least the anal* and internomedian veins feebly and rather broadly margined with black, and all the interspaces crowded with straight cross lines.

Length of fragment, 17 mm.; probable length of tegmina, 21.5 mm.; breadth, 7 mm.

This species bears a certain but not a striking resemblance in its neuration to the much stouter *E. mediana*, and a close relation in form and neuration to *E. rogi;* but from this latter the different character and extent of the externomedian area, as well as the longer mediastinal at once clearly separates it. Indeed the character of the externomedian area is quite different from that of any known species. In the character of the anterior half of the tegmina it is nearly related to *E. variegata.*

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2119 *a–b.*

54. ETOBLATTINA VARIEGATA.

Pl. VIII, fig. 10.

Etoblattina variegata Scudd., Proc. Bost. Soc. Nat. Hist., XXIV, 51–52 (1889).

Two additional specimens of this species have been found in the original locality by Mr. Huston.

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County.

55. ETOBLATTINA HILLIANA sp. nov.

Pl. VIII, fig. 11.

Tegmina oval, almost three times as long as broad, the costal margin strongly and regularly arcuate, the apex probably well rounded. Mediastinal area vittate, the vein straight nearly to the tip, which reaches the distal end of the middle fifth of the tegmina, the veins rather numerous, simple or forked, and less oblique than common. Externomedian vein broadly sinuate, much more strongly arcuate at base than apically, terminating not far before the apex of the tegmina, first forking at the end of the proximal third of the tegmina, with four or five strongly oblique, arcuate, simple, forked or multiple-forked branches. Externomedian vein very strongly sinuate in the middle of the tegmina, where the branches are thrown off straight and oblique, first branching a very little beyond the first scapular fork, with about five rather straight, longitudinal, simple, simply forked or doubly forked branches. Internomedian vein gently arcuate beyond the base, probably ending about the middle of the distal half of the tegmina, the earlier branches crowded, straight, simple, and oblique, the later more oblique, arcuate, and deeply forked. Anal furrow probably strongly arcuate and terminating not far from the end of the proximal third of the tegmina. Surface uniform, with scarcely the least sign of any cross lining.

Besides the larger part of two tegmina there is preserved a fragment of a pronotal shield which was probably of transverse oval form, much more strongly rounded in front than behind, broadest close to the posterior margin, and probably nearly half as broad again as long; its edge appears very delicately margined.

Length of entire fragment, 30 mm.; probable length of tegmina, 27.25 mm.; breadth, 9.5 mm.

This species is named after Mr. Homer D. Hill, of Morris, Ill., at the suggestion of Mr. Lacoe. Mr. Hill has been very persevering and successful in the search for fossil insects at Mazon Creek.

It does not seem to be very nearly related to any of our American species, but perhaps bears closer resemblance to *E. mazona* than to others; it shows some relation to the European *E. russoma.*

From the Lowest Productive Coal-measures of Mazon Creek, Morris, Grundy County, Ill. Mr. R. D. Lacoe; one specimen, No. 2070 *a–b*.

56. ETOBLATTINA ANGUSTA sp. nov.

Pl. VIII, fig. 8.

Tegmina very slender, two and a quarter times longer than broad, nearly parallel-sided in the middle third, tapering slowly beyond, the apex probably well rounded, the costal margin strongly convex only at base, the inner margin probably straight. Mediastinal area vittate but tapering constantly from the middle, the apex acuminate and reaching past the distal end of the middle third of the tegmina, the nearly straight simple branches of the vein changing from oblique to very oblique distally. Scapular vein straight or arcuate to its first fork (at the end of the proximal third of the tegmina), there bent and thereafter very broadly arcuate, in the middle as well as the proximal third of the tegmina subparallel to the costal margin, terminating scarcely before the very apex of the tegmina; there are about five long, nearly straight, simple or deeply forked branches. The externomedian vein is arcuate pretty regularly throughout, first forks opposite the first scapular fork, and has three or four longitudinal, gently arcuate, simple or forked branches. The internomedian vein is similarly arcuate, the area apically regularly attenuate, terminating but a little beyond the mediastinal vein at the distal end of the middle third of the tegmina, with four distant, straight, simple, strongly oblique branches. Anal furrow sharply impressed, terminating not far from the end of the proximal third of the tegmina. Surface blackish brown, the veins all edged rather broadly and indistinctly with black, the interspaces filled with crowded, straight, uniform cross lines.

Length of fragment, 13 mm.; probable length of tegmina, 16.5 mm.; breadth, 5 mm.

In the distribution of the neuration this species reminds one of the very much broader *E. funeraria*, but it differs in detail at every point.

It also resembles *E. hilliana* in a similar way. It is remarkable for the slenderness of the internomedian area, which is indeed hardly broader than the mediastinal.

From the Waynesburg coal (Upper Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2080 *a–b*.

57. ETOBLATTINA MACILENTA sp. nov.

Pl. VIII, fig. 9.

Tegmina scarcely less than three times as long as broad, ovate, tapering from well beyond the middle, the costal margin strongly convex at base, but beyond very faintly arcuate, not more so than (if as much as) the inner margin, the apex probably strongly rounded. Mediastinal area apically acuminate, reaching nearly to the distal end of the middle third of the tegmina, the branches of the vein straight, simple, very oblique. Scapular vein gently sinuate, terminating scarcely short of the extreme apex of the tegmina, first forking at about the end of the proximal third of the tegmina, with about four longitudinally oblique branches, the first doubly forked, the others simple and nearly straight. Externomedian vein nearly straight beyond the arcuate base, first forking somewhat, though not greatly, beyond the scapular vein, with about three longitudinal simple or deeply forked branches. Internomedian vein straight beyond the basal arcuation, terminating about the middle of the distal two-fifths of the tegmina, with straight, simple or forked, oblique branches. Anal furrow terminating not far from the end of the basal third of the tegmina, pretty regularly and strongly arcuate, situated at the depth of a depression; anal veins simple or occasionally deeply forked, arcuate, crowded. Surface uniformly black, with feeble signs of rather distinct straight cross lining in the interspaces.

Length of two fragments in juxtaposition, 10 mm.; probable length of tegmina, 12.25 mm.; breadth, 4.25 mm.

This species appears to be more closely allied to *E. angusta* than to any other, but differs much from it, not only in form but in the character of the externomedian and the width of the longer internomedian area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va., Mr. R. D. Lacoe; one specimen, No. 2121 *a–b*.

58. ETOBLATTINA EXILIS.

Pl. IX, fig. 1.

Etoblattina exilis Scudd., Bull. U. S. Geol. Surv., No. 101, 17, pl. 2, fig. *e* (1893).

From the Lower (?) Productive Coal-measures of East Providence, R. I.

59. ETOBLATTINA ROGI sp. nov.

Pl. IX, figs. 2, 3.

Unfortunately the basal third or more is lost from both the specimens of this evidently distinct species, and the precise form and proportions are necessarily conjectural, but the main features of the neuration are preserved. The tegmina are evidently almost or quite three times as long as broad, lanceolate, with almost equally and gently arcuate costal and inner margins, the apex subacuminate but rounded. The mediastinal area is broad and tapers regularly in the distal half, ending not far from the distal end of the middle fifth of the tegmina, the branches of the vein long, simple, straight, exceedingly oblique. Scapular vein very gently arcuate, terminating only a little before the extreme apex of the tegmina, first forking near the end of the proximal third of the tegmina, the branches simple, very deeply forked, straight, and longitudinally oblique. Externomedian vein beyond the basal arcuation straight and oblique, first forking not far from the first scapular fork, with four or five straight, longitudinal, simple or forked, occasionally doubly forked, apically arcuate branches. Internomedian vein like the preceding, terminating not far from the middle of the distal half of the tegmina, the branches mostly simple, straight, exceedingly oblique. Anal furrow ending just within the end of the proximal two fifths of the tegmina. Surface blackish-brown, the veins black and narrowly edged with black, the interspaces filled with distinct, closely crowded, straight cross lines.

Length of fragments, 12 to 15 mm.; probable length of tegmina, 18 to 20.75 mm.; breadth, 6.5 to 7.25 mm.

This species shows a certain resemblance to the similarly shaped *E. prædulcis*, but has a shorter internomedian area and a very different externomedian area. In one specimen the scapular vein first forks a little before, in the other a little after, the internomedian vein.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2122 *a*, *b–c*, besides two others probably belonging here.

60. ETOBLATTINA EXPUGNATA sp. nov.

Pl. IX, fig. 4.

Tegmina subovate, tapering from the middle, a very little less than three times as long as broad, the costal margin rather strongly and rather regularly arcuate, the inner margin nearly straight, the apex well rounded. Mediastinal area vittate, moderately broad, tapering only near tip, which reaches fully to the end of the middle third of the tegmina, the branches of the vein not very frequent, straight, simple, and oblique, the distal branches very oblique indeed. Scapular vein arcuate, terminating just short of the extreme apex of the tegmina, the branches, four in number, arcuate, longitudinally oblique, and simple or deeply forked. Externomedian vein arcuate, more strongly basally than apically, first forking just after the scapular, with four nearly straight, simple or deeply or apically forked branches. Internomedian vein gently sinuate, terminating not long before the apex, but before the scapular vein, the branches distant, gently sinuate, mostly simple, oblique, and apically very oblique. Anal furrow regularly and strongly arcuate, very deeply and sharply impressed, especially in the basal half, terminating at about the end of the proximal two-fifths of the tegmina; anal area vaulted, prominently so at the upper base, the veins mostly simple, occasionally deeply forked, more or less arcuate. Surface uniformly black, the interspaces with crowded, straight cross lines.

Length of tegmina, 18.25 mm.; breadth, 6.5 mm.

Except in its much longer mediastinal area, this species closely resembles *E. communis;* its narrower form and less arcuate internomedian vein separate it from *E. mactata*, to which in its general neuration it is nearly allied; and it bears a great deal of resemblance to *E. secreta*, but has a shorter and broader internomedian area and different development of the mediastinal area; it differs similarly from the next species, *E. obatra*, to which it is very closely allied, but has a longer and slenderer anal area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2085 *a–b*.

61. ETOBLATTINA OBATRA sp. nov.

Pl. IX, fig. 5.

Tegmina subovate, slightly more than three times as long as broad, broadest just before the middle, the costal margin considerably arcuate but less so in the middle half, the inner margin straight, the apex well rounded. Mediastinal area vittate, tapering in the apical third, reaching nearly to the distal end of the middle third of the tegmina, the branches of the vein mostly simple, arcuate, and excessively oblique. Scapular vein beyond the basal arcuation faintly arcuate, terminating just before the apex of the tegmina, first forking considerably within the proximal third of the tegmina, with about four deeply forked or simple, arcuate, longitudinally oblique branches. Externomedian vein beyond the probably strong basal arcuation nearly straight and oblique, first forking about opposite the end of the anal furrow, with three longitudinal or nearly longitudinal, apically forked or deeply doubly forked, nearly straight branches. Internomedian vein sinuate, being slightly arcuate at base, faintly arcuate at tip, ending not a great way before the apex of the tegmina at the edge of the apical border, the infrequent branches straight, the proximal oblique, the distal excessively oblique, and both simple or forked. Anal furrow strongly arcuate, sharply impressed, terminating a little short of the end of the proximal two-fifths of the tegmina; anal veins arcuate and numerous. Surface uniformly black, with faint, moderately close cross lines in the interspaces.

Length of tegmina, 17 mm.; breadth, 5.25 mm.

In the general direction of the veins and extent of the areas this species shows a great resemblance to *E. exsecuta*, but the tegmina are much slenderer, the mediastinal branches far more oblique, and the externomedian neuration simpler. It bears almost a greater resemblance, both in venation and in the form of the tegmina, to *Gerablattina concinna*, but the mediastinal area is much shorter. From the preceding species, *E. expugnata*, to which it is closely allied, it differs in form, in the crowding and obliquity of the mediastinal branches, and in the more abbreviated and relatively broader anal area.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2123 *a–b*.

62. ETOBLATTINA IMPERFECTA sp. nov.

Pl. IX, fig. 8.

Tegmina ovate, three times as long as broad, tapering only on the apical third, the middle portion equal, the costal margin gently arcuate, the inner margin straight beyond the considerable arcuation of the anal area, the apex probably well rounded. Mediastinal area moderately narrow, vittate, tapering in less than the distal third, terminating but little before the middle of the distal half of the tegmina, the branches of the vein mostly deeply forked, exceedingly oblique and arcuate. Scapular vein gently and pretty uniformly sinuate, terminating just above the apex of the tegmina, first forking opposite the tip of the anal furrow, with about four gently arcuate, deeply forked or simple, longitudinally oblique branches. Externomedian vein gently sinuate, first forking opposite the scapular, and with but this single straight and deeply forked, perhaps compound, longitudinal branch. Internomedian vein arcuate, but nearly straight in the apical half, terminating but little before the very apex of the tegmina, as near it as the scapular vein; the branches are distant, the proximal simple and oblique, the distal forked or doubly forked, very oblique and gently arcuate. Anal furrow strongly arcuate, deeply impressed in basal half, and terminating at the end of the proximal two-fifths of the tegmina; anal veins few, arcuate, simple. Surface uniformly black, the interspaces with excessively faint, close, and straight cross lining.

Length of fragment, 12.5 mm.; probable length of tegmina, 16.5 mm.; breadth, 5.5 mm.

In the general features of its neuration this species agrees at all points with *E. obatra*, but the internomedian area is slightly longer, the externomedian area of much less importance, the costal margin not so convex and the anal area distinctly fuller. In the forking and greater longitudinality of the mediastinal branches and the paucity of the externomedian neuration it is distinctly different from *E. secreta* that follows.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2124 *a–b*.

63. ETOBLATTINA SECRETA sp. nov.

Pl. IX, figs. 6, 7.

Tegmina about three times as long as broad, ovate, broadest in the middle, but sometimes not tapering for some distance beyond, with rather strongly arcuate costal margin and straight inner margin, the apex probably well rounded. Mediastinal area vittate, not very broad, apically acuminate, reaching to about the distal end of the middle third of the tegmina, the branches of the vein not numerous, very oblique, sometimes exceedingly oblique, mostly simple. Scapular vein more or less sinuate, terminating just before the very apex, first forking at about the end of the proximal end of the tegmina, with five or six arcuate, mostly simple, sometimes deeply forked, exceedingly oblique branches. Externomedian vein sinuate, much more strongly arcuate at base than apically, first forking well beyond the scapular and not far from a point opposite the tip of the anal furrow, the three or four branches nearly straight and longitudinal, simple and deeply forked or occasionally doubly forked. Internomedian vein similar to the externomedian or slightly less sinuous, ending before the apex but reaching almost as far as the scapular, the branches rather distant, the first and sometimes the last deeply forked, the others mostly simple, straight or faintly arcuate, very oblique. or apically exceedingly oblique. Anal furrow not very strongly arcuate, well impressed, terminating at about the end of the proximal two-fifths of the tegmina; anal area vaulted, especially next the basal half of the furrow, the branches relatively few and arcuate. Surface uniformly black, with rather crowded straight cross lines in the interspaces.

Length of fragment, 15 to 15.5 mm.; probable length of tegmina, 18.5 to 19 mm.; breadth, 6.25 to 6.5 mm.

This species is closely allied to *E. imperfecta*, from which it differs principally in the distance from the base at which the scapular and externomedian veins first fork, in the general character of the externomedian vein, and in the less crowded branching of the mediastinal vein. Similar differences separate it from *E. obatra*, while the slenderer mediastinal area and greater extension of the internomedian area distinguish it from *E. expugnata*. It is also nearly allied to *E. exsecuta*, but in that species the scapular and externomedian veins first fork side by side, and in the broader anal area the veins are more crowded. Its greater slenderness separates it from *E. communis*, with which it agrees almost completely in its neuration; the mediastinal area, however, is distinctly longer than in that species.

The two specimens figured differ considerably from each other in the form of the tegmina, the obliquity of the mediastinal branches, and the sinuosity of the scapular vein, but I am inclined to think they should be regarded as belonging to one species.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; four specimens, Nos. 2125 *a–b*, *c–d*, *e–f*, *g*, besides another presumably to be referred here.

64. ETOBLATTINA RELIQUA.

Pl. IX, fig. 10.

Etoblattina reliqua Scudd., Bull. U. S. Geol. Surv., No. 101, 18–19, pl. 2, fig. *g* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

65. ETOBLATTINA INVISA sp. nov.

Pl. IX, fig. 9.

Tegmina about three times as long as broad, ovate, largest a little before the middle, but with nearly parallel sides, the costal margin and inner margin equally and very gently arcuate in the middle two-thirds, the humeral angle probably strongly rounded, the apex well rounded. Mediastinal area moderately broad, vittate, rather rapidly tapering apically and reaching beyond the distal end of the middle third of the tegmina, the vein with few, oblique, simple branches. Scapular vein beyond the basal arcuation almost rigidly straight and terminating just short of the very apex of the tegmina; it first forks at the middle of the tegmina and has about five simple branches, like those of the mediastinal area. The externomedian vein, straight in its middle course, is broadly sinuate, first forking a little before the end of the mediastinal vein, and has three arcuate, apically longitudinal, simple, distant branches. The internomedian vein is broadly sinuate and terminates at some distance before the apex, the few branches distant, a little arcuate, the first probably deeply forked, the others simple. Anal furrow very elongate, but little arcuate and not greatly impressed, terminating beyond the proximal two-fifths of the tegmina. Surface gray, the veins all marked and broadly margined with black, in which margin only are seen straight and crowded cross lines in its interspaces.

Length of fragment, 16 mm.; probable length of tegmina, 17.5 mm.; breadth, 6 mm.

This species seems to be very different from the other open-veined Etoblattinæ, particularly in the late forking and unimportant character of the externomedian vein, carried to excess in *E. strigosa;* it has a certain general resemblance to *E. ramosa*, but has a far more simple neuration, in which hardly a branch is forked.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2126 *a–b*.

66. ETOBLATTINA OCCULTA sp. nov.

Pl. IX, fig. 13.

Tegmina nearly parallel sided, oval, about three times as long as broad, the larger part of the costal margin very gently arcuate, the inner margin nearly straight, the apex probably well rounded. Mediastinal area narrow, vittate, tapering only apically, reaching to the middle of the distal half of the tegmina, the branches of the vein tolerably numerous, gently arcuate, oblique or very oblique, almost invariably simple. Scapular vein arcuate at base, beyond the first fork (at the end of the proximal third of the tegmina) having a general straight course and ending a little way before the apex of the tegmina, the first branch arising far before the others, the others, four or five in number, subequidistant, simple or forked, arcuate and exceedingly oblique. Externomedian vein gently sinuate, first forking well beyond the scapular, the three or four branches distant, longitudinally oblique and simple or forked or perhaps compound. Internomedian vein strongly sinuate, especially basally, terminating a little way before the apex, probably as far or nearly as far as the scapular vein, the latter half of the area slender, the proximal half with very distant, oblique, arcuate, mostly simple branches. Anal furrow strongly arcuate, strongly impressed, terminating a little within the end of the proximal two-fifths of the tegmina; anal area slightly vaulted, the veins in the portion next the furrow distant and strongly arcuate, those distant from it crowded, gently and oppositely arcuate, all simple. Surface carbonaceous black with elongate gray patches between the veins, or it may be described as gray with very broad black margins to all the veins, often confluent, especially at the ends of the interspaces; the black portion is traversed by rather crowded straight cross lines.

Length of fragment, 17 mm.; probable length of tegmina, 26 mm.; breadth, 9 mm.

This species is somewhat related to *E. balteata*, but differs in its form and the particular character of each of the areas. From the next species, *E. defossa*, it differs particularly in the very different formation of the externomedian vein. The neuration is strikingly similar to that of *Gerablattina diversinervis*, and the great length of the mediastinal vein makes it closely resemble a Gerablattina; it seems, however, to belong better here.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2127 *a–b*.

67. ETOBLATTINA LATEBRICOLA sp. nov.

Pl. IX, fig. 11.

Tegmina nearly three times as long as broad, ovate lanceolate, with unusually subacuminate apex, the costal margin gently arcuate beyond the strongly rounded humeral curve, the inner margin gently arcuate beyond the anal furrow, the anal margin gently arcuate independently. Mediastinal area vittate, moderately narrow, tapering only beyond the middle of the tegmina, reaching nearly to the middle of the distal half of the tegmina, the branches of the vein oblique or very oblique, simple or apically forked. Scapular vein very gently and broadly sinuate, terminating but little before the very apex of the tegmina, first forking a little beyond the proximal third of the tegmina, the three equidistant branches considerably arcuate, longitudinally oblique, deeply and simply or doubly forked. Externomedian vein arcuate, first forking just beyond the scapular vein, the four or five branches longitudinal and straight, simple or deeply forked or compound, both the scapular and externomedian branches being very crowded in the apical fourth of the tegmina. Internomedian vein very gently arcuate, the area apically extended slightly so as to terminate almost as near the apex as the scapular vein, the branches distant, the proximal nearly straight, simple and very oblique, the distal more oblique and mostly forked. Anal furrow not very strongly but uniformly arcuate, somewhat strongly impressed, terminating a little before the end of the proximal two-fifths of the tegmina; anal area strongly vaulted next the furrow, the veins simple and arcuate. Surface black, with straight rather crowded cross lines on either side of the main veins in the central portions of the tegmina but not crossing the interspaces.

Length of tegmina, 17.5 mm.; breadth, 6 mm.

From the Lower (?) Productive Coal-measures of East Providence, R. I. Mr. R. D. Lacoe; one specimen, No. 2091 *a–b*.

68. ETOBLATTINA DEFOSSA sp. nov.

Pl. IX, fig. 12.

Tegmina elongate, probably more than three times as long as broad, ovate, the costal margin gently arcuate, the inner less so, the apex probably well rounded. Mediastinal area long and moderately wide, apically acuminate, reaching nearly or quite to the middle of the distal half of the tegmina, the branches of the vein distant, mostly simple and very oblique. Scapular vein nearly straight, apically faintly arcuate, terminating a little before the apex, the first branch arising far before the others, and all, four in number, simple or deeply or doubly forked, arcuate and longitudinally oblique. Externomedian vein first forking well before the middle of the tegmina and probably not far from the first scapular forking, this first externomedian fork and the main vein parting like a longitudinal narrow fork and each fork very deeply forked, sometimes with a secondary deep fork, all longitudinal and sometimes arcuate. Internomedian vein in the apical half of its course subparallel to the inner border and, by means of a superior supplementary, deeply forked, arcuate, superior branch, extending the area nearly to the apex of the tegmina, the other branches distant, simple, arcuate, strongly oblique. Surface black, the interspaces with crowded, irregular, tremulous cross lines, forming in places almost an irregular reticulation.

Length of fragment, 14.5 mm.; probable length of tegmina, 28.75 mm.; breadth, 8.5 mm.

This species is closely allied to the preceding, but is apparently slenderer, and differs from it in many important features, and especially in the character of the externomedian vein. In this last characteristic it more nearly resembles *E. tenuis*, but in the character of the upper part of the tegmina it is very different from it.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2128 *a–b*.

69. ETOBLATTINA RECIDIVA sp. nov.

Pl. IX, fig. 14.

Tegmina probably about three times as long as broad, lanceolate, the costal margin gently convex, the inner nearly straight, the apex subacuminate, but well rounded. Mediastinal area terminating somewhat short of the distal end of the middle third of the tegmina, the branches of the vein very oblique and simple. Scapular vein very straight, terminating but little short of the apex, the first branch arising far before the others, rather deeply forked and bent at the fork; the others like this fork straight, very oblique indeed, and simple or forked. Externomedian vein probably nearly straight throughout and longitudinally oblique, first forking probably beyond the scapular and about at the end of the proximal third of the tegmina, the four or five branches straight, longitudinal and simple or forked. Internomedian vein beyond the basal curve nearly straight, but as a whole sinuate, terminating not much beyond the middle of the distal third of the tegmina, the branches rather distant, simple, arcuate, and oblique, or very oblique. Surface black, traversed by delicate, irregular and tremulous, crowded cross lines in all the interspaces.

Length of fragment, 8 mm.; probable length of tegmina, 19.5 mm.; breadth, 6.25 mm.

This species is perhaps as nearly allied to *E. hastata* as to any other of our species, but is very different indeed from it.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2129*a*.

ETOBLATTINA sp.

Pl. X, figs. 14, 15.

A single specimen with its reverse shows an unusually complete and excellently preserved hind wing, which must be referred to this genus. The wing is subovate, subacuminate at tip, with very gently arcuate costal and inner margins. The mediastinal vein runs parallel and close to the costal margin, with a few strongly oblique branches in an apical cluster, and a subbasal branch which runs between the main vein and the margin and is lost. The scapular vein is very straight, running to scarcely below the extreme apex of the wing, first branches a little before the middle of its course, and has four simple, forked, longitudinal branches. The externomedian vein is similarly straight, a little divergent from the scapular vein, first branches a little earlier than it, and has three long, simple, almost longitudinal branches. The internomedian vein is rigidly straight, and ends slightly further out than the mediastinal vein, with five parallel, straight, mostly simple or oblique branches. The anal furrow seems to differ from the other anal veins in there being a step in the membrane at this point, the vein itself, like the other anal veins, being more delicate than the internomedian branches next it and less deeply impressed; most of it can be traced, and, except for the points mentioned, it appears quite as a branch of the internomedian, being straight, except for an apical sinuation, and parallel to the intermomedian branches; the other anal veins, of which only the apical halves appear, are similar in delicacy and direction, but gradually become more crowded, as is usual in the tegmina, and slightly arcuate; the furrow ends on the inner margin, slightly beyond a point opposite the first forking of the scapular vein. Surface uniformly blackish, the interspaces, at least near the apical margin, filled with not very close, straight but irregular cross lines.

Length of fragment, 10.5 mm.; probable length of wing, 14.5 mm.; breadth, 6.5 mm.

This is the only hind wing of an Etoblattina known to me in which any part of the anal area is preserved.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2084 *a–b*.

ETOBLATTINA sp.

Pl. XII, fig. 2.

Etoblattina sp. Scudd., Bull. U. S. Geol. Surv. No. 101, 13–14, pl. 2, fig. *c* (1893).

In the paper quoted I regarded this as a fragment of a fore wing from near the middle, somewhat allied to *E. primæva*. A renewed study shows that the costal curve is a natural one and that the fragment is rather the apical portion (with part of the tip lost) of a hind wing, in which, possibly, the tip of the internomedian vein is included. It appears to belong to Etoblattina, but its special relations are indeterminable.

From the Lower (?) Productive Coal-measures of East Providence, R. I.

ETOBLATTINA (?) sp.

Pl. XII, fig. 4.

Etoblattina sp. Scudd., Bull. U. S. Geol. Surv. No. 101, p. 16, pl. 2, fig. *k* (1893).

For further remarks on this hind wing see p. 29.

From the Lower (?) Productive Coal-measures of Cranston, R. I.

10. Genus GERABLATTINA.

Gerablattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 97–98 (1879); Foss. Ins. N. A., I, 117–118 (1890).

Next to Etoblattina, from which this genus is but slightly differentiated, Gerablattina is the prevailing type of Palæoblattariæ, at least in this country. It appears first in the Millstone Grit—a single species in the Pennsylvania coal field—and it extends to the Permian, where it culminates, but it has not been recognized, like Etoblattina, in the Trias. Nearly three-quarters of the twenty-one species of this country come from the Permian, and, indeed, from the single locality at Cassville, W. Va., three from the Barren Coal-measures of Ohio, and the remaining two from the Oldest Productive Coal-measures of Rhode Island. Its absence from all Western deposits is a little curious.

In Europe its standing is disputed by Anthracoblattina, which there assumes exceptional importance. The ten species found there enjoy nearly the same geologic range as here and the same as Anthracoblattina, Hermatoblattina, and Etoblattina in Europe, namely, from the Lowest Productive Coal-measures to the Permian, inclusive, culminating, apparently, in the Upper Carboniferous deposits.

Table of the species of Gerablattina.

a^1. All the main veins independent from or almost from the base.
  b^1. Tegmina relatively slender, considerably more than twice as long as broad.
    c^1. Mediastinal area very narrow, in its middle at most hardly more than one-fifth the width of the tegmina; internomedian branches relatively distant.
      d^1. Anal area relatively long; scapular vein first branching opposite or before the extremity of the anal area.
        e^1. First internomedian branch very oblique, thrown off far before the end of the anal area.................................. 1. *G. inculta.*
        e^2. First internomedian branch nearly transverse, thrown off scarcely before the end of the anal area......................... 2. *G. perita.*
      d^2. Anal area[1] relatively short; scapular vein first branching far beyond the extremity of the anal area.

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[1] This point not known in *G. apicalis.*

Table of the species of Gerablattina—Continued.

e^1. Scapular area reaching the extreme apex of the tegmina.. 3. *G. apicalis.*
e^2. Scapular area not reaching the extreme apex of the tegmina.
f^1. Scapular vein first forking far before the middle of the tegmina, less abundantly branched than the externomedian. 4. *G. diversinervis.*
f^2. Scapular vein first forking but little before the middle of the tegmina, and more abundantly branched than the externomedian. 5. *G. richmondiana.*
c^2. Mediastinal area relatively broad, in its middle at least a fourth the width of the tegmina; internomedian branches relatively close.
d^1. All the mediastinal branches simple, or simply forked.[1]
e^1. Internomedian area long drawn out, extending at least as far as, generally much farther than, the mediastinal area.
f^1. Internomedian area reaching, or almost reaching, the extreme tip of the tegmina.
g^1. Internomedian area band shaped, tapering but little, the branches numerous and relatively short.................... 6. *G. cassvici.*
g^2. Internomedian area triangular, tapering much, the branches few and relatively long.................................... 7. *G. abdicata.*
f^2. Internomedian area falling distinctly, often considerably, short of the extreme tip of the tegmina.
g^1. Scapular and externomedian areas about equally important, each throwing at least half a dozen veins to the margin.
h^1. Tegmina very slender, fully three times as long as broad. 8. *G. concinna.*
h^2. Tegmina less slender, not more than two and a half times longer than broad.................................... 9. *G. uniformis.*
g^2. Scapular and externomedian areas very unequally important, one or the other with at most three or four veins on the margin.
h^1. Anal area long, nearly reaching the middle of the tegmina; externomedian area unimportant................. 10. *G. permanenta.*
h^2. Anal area short, about one-third the length of the tegmina, scapular area unimportant.......................... 11. *G. permacra.*
e^2. Internomedian area rapidly tapering, barely or not reaching the middle of the distal half of the tegmina.
f^1. Anal area short and broad; general course of the scapular branches arcuate in a sense opposite to that of the anal furrow. 12. *G. eversa.*
f^{12}. Anal area long and narrow; general course of the scapular branches longitudinal and straight....................... 13. *G. deducta.*
d^2. Very nearly all the mediastinal branches forked and some of them compound.
e^1. Tegmina more than 40 mm. long; internomedian and mediastinal areas of very unequal length; scapular and externomedian areas of nearly equal importance; scapular branches only very slightly arcuate.................................. 14. *G. scapularis.*
e^2. Tegmina less than 20 mm. long; internomedian and mediastinal areas of equal length; scapular and externomedian areas of distinctly unequal importance; scapular branches considerably arcuate. 15. *G. fraterna.*
b^2. Tegmina relatively stout, but little or not more than twice as long as broad.

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[1] In *G. abdicata* only are they sometimes doubly forked at extreme tip.

Table of the species of Gerablattina—Continued.

- **c^1. Scapular area important, first forking in basal half of tegmina, with half a dozen branches on margin.**
    - **d^1. Main scapular vein striking the margin below the apex of the tegmina. 16. *G. radiata.***
    - **d^2. Main scapular vein striking the margin at the apex of the tegmina.**
        - **e^1. Tegmina subequal in breadth, broadly rounded at apex; main externomedian and internomedian veins sinuous.**
            - **f^1. Mediastinal area subequal throughout, the main vein sinuous. 17. *G. lata.***
            - **f^2. Mediastinal area narrowing throughout, the main vein straight. 18. *G. rotundata.***
        - **e^2. Tegmina greatly tapering in distal half, the apex subacuminate; main externomedian and internomedian veins straight beyond the arcuate base.................................. 19. *G. ovata.***
- **c^2. Scapular area unimportant, first branching far beyond the middle of the tegmina and with only three or four branches on margin. 20. *G. minima.***

b^2. Externomedian and internomediam veins joined with the scapular in the basal sixth of the tegmina......................... 21. *G. fascigera.*

1. GERABLATTINA INCULTA sp. nov.

Pl. IX, fig. 16.

A single fore wing, not very well preserved and with the apical third lost, is all that represents this species. It is long obovate in form, nearly equal in breadth, except at the extreme end, largest in the middle, and probably about two and a half times longer than broad. The mediastinal area probably extended to the middle of the distal half of the wing, and is very narrow and equal, hardly more than a fifth the breadth of the wing; the branches of the vein are five or six in number, mostly thrown off from the proximal half of the vein, simple or simply forked and exceptionally longitudinal. The scapular vein recedes slightly from the margin in passing down the tegmina, and probably terminates at the apex; it has only two or three straight, longitudinal, sometimes very deeply forked offshoots from its only superior branch, which is thrown off at about the middle of the proximal half of the tegmina. The externomedian vein is a reversed repetition of the scapular, but branches at the middle of the tegmina only. The internomedian vein is very gently arcuate, first branches about as early as the scapular vein, has only four or five gently arcuate or straight simple branches, and extends as far as the mediastinal vein. The anal furrow is impressed moderately in only its proximal half, is bent slightly in the middle and otherwise considerably arcuate, terminating at the middle of the tegmina; the anal veins, seven or eight in number, are subparallel, successively more distant and more arcuate toward the anal furrow, and most of them simple. The surface of the tegmina is black and marked with exceedingly close cross lines at right angles to the veins they connect.

Length of fragment, 11.25 mm.; probable length of tegmina, 14.6 mm.; breadth, 6.6 mm.

The single specimen is from the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, No. 2139*a*.

2. GERABLATTINA PERITA sp. nov.

Pl. IX, fig. 17.

The tegmina, of which only the basal portion of one is preserved, are apparently of an elongate and nearly equal form, to judge from the form of the base and the general course of the branches; certainly it must have been considerably more than twice as long as broad. The mediastinal area is exceedingly narrow, riband-like, but its exact extension can not of course be told; the vein runs parallel to the margin throughout its course, and in the middle of the wing can not occupy more than a fifth the width of the tegmina; the branches are rather distantly oblique, rather strongly arcuate, and simple. The scapular vein first forks at about opposite the tip of the anal furrow, the fork diverging somewhat strongly from the main branch, and neither the main stem nor the branch forks again in the fragment, or probably before the middle of the wing. The externomedian vein is rather strongly arcuate in the basal half of the tegmina, where it is entirely simple and is somewhat widely distant from the scapular vein. The internomedian vein is similarly or a little more strongly arcuate, diverging slightly from the externomedian before it begins to branch; it begins to throw off branches opposite the first forking of the scapular, and the two forks which are preserved in the fragment are somewhat distant and obliquely transverse. The anal area is but very slightly vaulted, the furrow strongly arcuate, terminating evidently at some distance before the middle of the tegmina; the veins are arcuate in the same sense, simple, and more and more crowded away from the anal furrow. The entire surface is traversed by finely incised, closely approximate, tremulous cross lines, and all the main veins and their main branches are broadly banded with piceous, leaving between them and along the outer edge of the main mediastinal vein (independent of its nervules) narrow colorless stripes.

Length of fragment, 9.5 mm.; probable length of tegmina, 17.5 mm.; width at extremity of anal furrow, 5.25 mm.

The single specimen and its reverse from the Waynesburg coal (Lower Permian) of Cassville, W. Va., are in the collection of Mr. R. D. Lacoe, under the number 2140 *a–b*.

3. GERABLATTINA APICALIS sp. nov.

Pl. IX, fig. 18.

Only the apical half, more or less, of one of the tegmina is preserved, so that the proportions of the same can not be definitely determined, but it was apparently of nearly the same proportions as the following *species.* The mediastinal area is not preserved in any portion of its course, unless it be by the veins which are seen a little before the tip of the tegmina, but whose origin is lost. This would appear to be entirely uncertain, though it would seem as if the basal one belonged to this area, which would then correspond very closely in its extent with the following species; but in that case, to judge by the course of the scapular veins, the width of the mediastinal area must have been fully as great as there, if not greater. The scapular area, however, was of extraordinary extent, the main vein running in the apical half of the tegmina parallel to and at a great distance from the front margin and terminating exactly at the apex of the tegmina, throwing off in the apical portion three simple or deeply forked branches, having each a longitudinal course, and with no such sinuous curvature as is found in the next species. The main externomedian vein in the apical half of the tegmina runs again parallel to and at a wide distance from the scapular vein, terminating on the inner margin and sending to the apical portion of the same three simple, rather distant branches, the first of which is forked just before its tip; in the apical portion of its course the externomedian vein diverges slightly from the scapular and approaches apically the internomedian vein. This latter terminates on the apical half of the outer border, apparently very much in the same way as in *G. diversinervis*, the area appearing apically to be very much narrowed and possessing only simple, very distant and oblique branches; in the apical portion of its course the vein takes on a more longitudinal direction and thus approaches more closely to the externomedian vein, leaving between the two a constantly narrowing interspace much after the fashion of Spiloblattina. The entire surface of the fragment is black, excepting for dashes of the dark-gray color of the stone in the interspaces.

Length of fragment, 10.5 mm.; probable length of the tegmina, 20 mm.; apparent breadth near the middle of the tegmina, 8 mm.

Richmond, Ohio, from the Lower Barren Coal-measures, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, collected by Mr. S. Huston; No. 112.

4. GERABLATTINA DIVERSINERVIS sp. nov.

Pl. IX, fig. 15.

A single specimen of the tegmina with its reverse, showing the nearly complete wing, the apical portion only wanting, represents a species having a very elegant form, apparently nearly three times as long as broad, with the inner margin straight, the costal margin rather strongly and equally convex. The mediastinal area is riband-shaped and extends to the exact tip of the fragment or probably to well beyond the middle of the apical half of the wing; the area is narrow, in its middle hardly more than a fifth the width of the tegmina, the vein with oblique and increasingly oblique, simple, scarcely arcuate branches, numerous and subequidistant. The main scapular and externomedian veins are somewhat widely distant from each other and from the veins on either side of them in the middle of the tegmina; the scapular is gently sinuous throughout its course, begins to fork a little beyond the basal third of the tegmina, and has four at origin strongly inequidistant, closely crowded, simple or simply forked branches, apically upcurved toward the margin of the tegmina and here no more distant from each other than the mediastinal branches; the outermost carry the scapular area only half way from the mediastinal area to the apex of the tegmina. The externomedian vein beyond its basal curvature is nearly straight throughout the greater portion of its course and emits three rather distant and at their origin widely distant, straight and longitudinal branches, simple or forked. The internomedian vain is gently sinuous throughout its course, rapidly narrows beyond its base, and extends to at least as far as, probably slightly farther than, the mediastinal area, and is furnished with seven or eight widely distant, gently arcuate, obliquely transverse, apically oblique, simple branches. The anal area is scarcely vaulted, the anal furrow deeply incised, strongly arcuate, terminating hardly beyond the middle of the basal half of the tegmina; the anal veins are few, irregularly arcuate in the same sense as the anal furrow, and rather widely distant. Along the whole all the veins and branches are broadly banded, in the mediastinal area narrowly banded, with piceous, in which the membrane of the tegmina is seen to be delicately, transversely, and numerously cross veined.

Length of fragment, which is broken slightly at the base as well as at the tip, 19 mm.; probable length of the tegmina, 25 mm.; breadth, 9 mm.

This species is closely allied to *G. perita*, but markedly different from it in the narrow extent of the scapular area, which is far from reaching the extreme apex of the tegmina.

The single specimen and its reverse came from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and are in the collection of Mr. R. D. Lacoe, with the number 2141 *a–b*.

5. GERABLATTINA RICHMONDIANA sp. nov.

Pl. X, fig. 1.

This species is represented by only a single specimen, rather imperfect, but showing nearly the whole of the costal margin. The tegmina are apparently about two and one half times longer than broad, with a rather strongly and regularly arcuate costal margin; the apex is lost, but was apparently much as indicated in the figure. The mediastinal area is vittate, slightly broader than in its allies, being nearly a fourth the breadth of the tegmina in the middle, and ends a little beyond the middle of the distal half of the tegmina, the vein with rather distant, nearly straight, and strongly oblique nervules. The scapular vein is broadly sinuous, first forks only a little before the middle of the tegmina, beyond which it has numerous compound branches, the lowest of which strike the margin scarcely if at all above the extreme apex. The externomedian vein is broadly arcuate; its first visible branch arises a little beyond the middle of the tegmina, but it is here so much farther removed from the internomedian than from the scapular vein that probably an earlier branch, obscured from the imperfect preservation of the specimen, arises not far from opposite the first branch of the scapular vein; the behavior of the branches can not be seen from the imperfection of the specimen, but there is not room for the wide radiate arrangement of compound branches possessed by the scapular vein. The internomedian vein, only the proximal two-thirds of which can be traced, is broadly arcuate, and send out only a few distant, tolerably straight branches, the first of which is twice or thrice branched on the proximal side; it probably terminates about opposite the tip of the mediastinal vein. Only the merest fragment of the anal furrow can be seen, not far from the base, but it probably terminates not far from the end of the proximal third of the tegmina; none of the anal veins are preserved. There is no trace of banding or reticulation or cross lining on the surface.

Length of fragment, 20 mm.; probable length of tegmina, 25 mm.; probable breadth, 10 mm.

This species appears to be most nearly allied to *G. diversinervis*, but the tegmina are considerably stouter, with a more strongly arcuate costa, and it differs from all the preceding species, and more nearly resembles those which follow, in the greater relative width of the mediastinal area.

Lower Barren Coal-measures of Ohio, less than 100 feet above the Crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston, No. 169.

6. GERABLATTINA CASSVICI sp. nov.

Pl. X, figs. 2, 3.

This species is represented best by a nearly complete fore wing and its reverse, showing a form and proportions very similar to the preceding, the tegmina being apparently but little less than three times as long as broad, with a very strongly arcuate costal margin and a straight or nearly straight inner margin. The mediastinal area reaches well beyond the middle of the apical half of the tegmina, the main vein gradually approaching the apex during the apical half of its course, and supplied with rather numerous, strongly oblique, arcuate, and simple or forked branches. The scapular vein is very similar to that of the foregoing species, first branching well before the middle of the tegmina, and having three simple, forked, or compound branches, all of which have an upward curvature toward the costal margin, where the nervules are as closely crowded as in the mediastinal area, and the outermost of which extend the area of the scapular vein to scarcely more than half the distance from the mediastinal area to the apex of the tegmina. The externomedian vein beyond its basal curvature is nearly straight and passes with a gentle obliquity through the tegmina, subparallel to the costal margin, first forking just before the middle of the tegmina, and having in all four or five simple or simply forked, longitudinal veins, which occupy the apex of the tegmina. The internomedian vein runs in almost exact parallelism with, but at some distance from, the externomedian vein until the middle of the apical half of the tegmina, when, besides curving into a more longitudinal course, it sends from its upper margin a forked branch toward the tip of the tegmina, which it nearly reaches; the internomedian area, therefore, narrows very gradually, and has an exceedingly great extent, while the main vein has somewhat numerous, generally simple, but sometimes deeply forked, oblique, arcuate branches. The anal area is gently vaulted, the anal furrow deeply impressed, gently arcuate, and terminates but little before the middle of the tegmina; while the anal veins, similarly arcuate, are mostly simple and rather crowded, but especially so away from the anal furrow, where usually they are apically forked. In this species, too, all the veins and their branches are broadly banded with piceous, and where the veins or branches are closely approximate the banding of two or more adjoining stems may blend, and the wing is everywhere crossed in all the parts, whether piceous or otherwise, by fine, delicate, closely crowded cross lines.

Length of fragment, 21 mm.; probable length of tegmina, 25.5 mm.; breadth of same, 9 mm.

This species is closely allied to the preceding in many respects, but has a shorter, broader, and more tapering mediastinal area, much broader, more gradually tapering internomedian area, with much more crowded neuration, and which extends far nearer the apex of the tegmina.

Two specimens and their reverses have been found in the Waynesburg coal (Lower Permian) at Cassville, W. Va., and are in the collection of Mr. R. D. Lacoe, Nos. 2142 *a–b*, *c–d*.

7. GERABLATTINA ABDICATA sp. nov.

Pl. X, fig. 6.

The single specimen representing this species has lost the apical fifth of the tegmina and the anal area, but is otherwise well preserved. It is of a very regular, elongate ovate form, broadest in the middle, and somewhat less than two and one-half times as long as broad; the costal margin is very regularly and moderately convex, the inner margin very slightly convex. The mediastinal area is of normal width, and extends, decreasing in width only distally, some distance beyond the middle of the distal half of the tegmina; the vein has but five or six very longitudinally oblique and therefore long branches, simple or apically forked, sometimes doubly forked. The scapular vein is regularly and considerably arcuate, terminates just above the apex of the tegmina, first branches a little before the middle of the tegmina, and has only three or four simple, deeply forked, longitudinal, gently arcuate branches. The externomedian vein runs subparallel to the last, through the middle of the wing, first forks at about the middle, has but two or three nearly straight and simple longitudinal branches which fall upon the apical margin. The internomedian area reaches as far out as the scapular vein, is scarcely sinuous, and has only four or five long arcuate branches, the basal apically forked, the others simple. The anal furrow is gently impressed, rather strongly and pretty regularly arcuate, and terminates at the middle of the tegmina. The surface of the tegmina is blackish and is marked rather feebly by very close incised cross lines, nearly straight, but inclined to be tremulous, at right angles to the adjoining veins.

Length of the fragment, 14 mm.; probable length of tegmina, 16.5 mm.; breadth, 6.75 mm.

This species differs from *E. cassvici*, to which it is most nearly related, in the far greater breadth of the basal part of the internomedian area and in the relative unimportance and lower level of the externomedian area.

One specimen from the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, No. 2143*a*.

8. GERABLATTINA CONCINNA sp. nov.

Pl. X, figs. 4, 5.

This species is represented by a single specimen and its reverse, showing overlapping wings and tegmina, of which little can be made out, excepting the nearly complete uppermost of the tegmina, and a second specimen of an incomplete fore wing. The tegmina are very slender, slightly more than three times as long as broad, with a rather strongly arcuate costal margin, causing the tegmina to be nearly equal in their basal, somewhat rapidly tapering in their apical half, the apex falling well within the middle of the tegmina, the inner margin being straight. The mediastinal area reaches to the middle of the apical half of the tegmina, is moderately broad, tapers very regularly and uniformly in its apical half, and is filled with strongly oblique, increasingly oblique, and simple or forked, rather long branches. The scapular vein first branches at or somewhat beyond the end of the basal third of the tegmina, has a nearly straight or gently sinuous course toward the apex of the tegmina after passing its basal arcuation, and has four or five, at their origin widely distant but still closely crowded, simple or deeply forked branches, which run in a nearly straight and longitudinal course to the apical fourth of the costal margin. The basal portion of the externomedian vein and its first branch, which is not forked until shortly before the tip, run rather near to the main scapular vein, but after its first forking the externomedian vein has a straight and strongly oblique course to a point on the inner margin at some distance beyond the tip of the mediastinal area, and thereafter has three simple or deeply forked branches having a similar direction to that of the first fork. The internomedian vein is furnished with six or eight rather closely crowded, long, simple, oblique nervules. The anal area is considerably vaulted, the anal furrow deeply impressed, strongly arcuate, and terminates a little beyond the basal third of the tegmina; the anal nervules, six to eight in number, are gently arcuate in the same sense as the anal furrow, subequidistant and simple. The surface is uniformly black, gently vaulted in all the interspaces, excepting those of the internomedian and anal areas, with no banding and but very slight signs of any transverse striation.

Length of tegmina, 18.25 mm.; breadth, 5.9 mm.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, Nos. 2077 *a–b*, *c–d*.

9. GERABLATTINA UNIFORMIS sp. nov.

Pl. X, figs. 8–11.

Known by the tegmina only, which are about two and a half times longer than broad, with very gentle and uniform arcuation to the costal margin and straight inner margin, and probably a broadly rounded tip; the tip in all cases is broken. The mediastinal area is relatively broad and not very long, barely or not extending beyond the middle of the apical half of the tegmina, tapering only in its extreme portion, and filled with strongly oblique, infrequent, simple or forked, more or less arcuate branches. The scapular area must terminate just above the apex of the tegmina; first forking scarcely beyond the middle of the basal half of the same, it has four or five branches, all of which, mostly simple but occasionally deeply forked, have an upward gentle arcuation and on the costal margin are about as equally distant from each other as the mediastinal nervules. The externomedian vein is gently sinuous throughout its course, terminating beyond the middle of the apical third of the tegmina, beginning to fork nearly as soon as the scapular vein, and having in all only three simple or very deeply forked branches, all of which are nearly straight and longitudinal. The internomedian vein is exactly parallel to the externomedian, showing a gentle sinuosity throughout, and is furnished with six or seven simple or deeply forked, strongly oblique, and gently sinuous branches. The anal furrow is rather strongly arcuate, rather deeply impressed, and terminates some distance beyond the end of the basal third of the tegmina; the anal veins are simple and parallel to the anal furrow in its vicinity, where only they are preserved. The surface of the tegmina is uniformly black, approaching piceous, with very faintly perceptible, fine, closely crowded cross lines.

Length of the most perfect specimen (fragment), 13.5 mm.; probable length of tegmina, 17.5 mm.; breadth, 7 mm.

This species is nearly allied to the preceding, *G. concinna*, but is much less slender than it.

It is represented by four specimens from the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, all but one with reverses, which bear the numbers 2082 *a–b*, *c–d*, *e*, *f–g*.

10. GERABLATTINA PERMANENTA sp. nov.

Pl. X, fig. 12.

The tegmina are elongated, regularly and very gently tapering from near the base, and about two and three-quarters times as long as broad. The mediastinal vein extends to beyond the middle of the distal half of the tegmina, the rather narrow area gently narrowing, with half a dozen deeply forked or simple, longitudinally oblique branches, increasingly oblique distally. The scapular vein is at first straight, then bent at its first fork, at about the end of the proximal third of the tegmina, and, thereafter arcuate, crosses to the lower half of the tegmina and terminates a little below the apex; it has but three or four deeply forked, longitudinal, scarcely arcuate branches. The externomedian vein is very unimportant, first branching far beyond the middle of the tegmina and sending only three or four crowded nervules to the margin. The internomedian vein is nearly straight and oblique but apically arcuate, reaching at least as far as the mediastinal vein, with seven or eight equidistant, parallel, straight, simple, oblique branches, the apical ones more longitudinal and sometimes forked. The anal furrow is rather lightly impressed, slightly bent in the middle, and rather broadly arcuate, terminating just before the middle of the tegmina; the six or eight simple, subparallel, subequidistant anal veins are straight and longitudinally oblique, becoming gently arcuate as they approach the anal furrow. The surface of the tegmina is black, in places with distinct, close, incised cross lining.

The single specimen (with its reverse) shows a pair of crossed tegmina, of which only the more perfect, lacking only the extreme tip, is drawn.

Length of better fragment, 14.25 mm.; probable length of tegmina, 15.75 mm.; breadth, 5.7 mm.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, No. 2144 *a–b*.

11. GERABLATTINA PERMACRA sp. nov.

Pl. X, fig. 13.

Tegmina elongate elliptical in form, about three times as long as broad, with very gently and regularly arcuate costal margin and the margin of the anal area a little full. Mediastinal area broadening beyond the base, the vein being broadly sinuate and terminating at about the middle of the distal half of the tegmina; it has eight or nine simple, straight, oblique branches, more frequent in the distal than the proximal half. The scapular vein is very unimportant, although it first forks but little beyond the middle of the proximal half of the tegmina, for it further forks only just before the margin. The externomedian area is extensive; the vein first forks but little beyond the middle of the proximal half of the tegmina, and the two forks are of about equal importance; the upper, which must be regarded as the first branch, having three simple or forked inferior offshoots occupying the apex of the tegmina; the other two superior offshoots, one simple, the other deeply forked. The internomedian vein is very gently arcuate and reaches far beyond the middle of the distal half of the tegmina, and has only three or four longitudinally oblique, simple or forked branches. The anal furrow is very slightly impressed, somewhat strongly arcuate, and terminates scarcely beyond the proximal third of the tegmina; the anal veins are few in numbers, simple, equidistant, and arcuate, parallel to the anal furrow. The surface of the tegmina is blackish brown, and shows in places the feeblest possible signs of fine and close cross lining.

Length of fragment, 15.5 mm.; probable length of tegmina, 17 mm.; breadth, 5.65 mm.

A single specimen and its reverse collected by myself in the Waynesburg coal (Lower Permian) of Cassville, W. Va., shows the whole of one of the tegmina excepting the extreme base and the inner margin. No. 2187 and 2188, United States Geological Survey.

12. GERABLATTINA EVERSA sp. nov.

Pl. X, fig. 14.

The tegmina of this species are broadest at about the middle of the proximal half, and therefore taper apparently very slowly to the apex, and are presumably about two and one-half times longer than broad; but as in the only specimen known most of the margin is lost, much is conjectural in this respect. Assuming, what can not be far wrong, that our restoration of the outline is correct, the mediastinal area, which is of normal width and similar to that of the next preceding species, terminates at about the middle of the distal half of the tegmina and the vein has six or seven straight, longitudinally oblique, simple branches. The scapular vein must terminate about at the apex of the tegmina, being broadly arcuate, with only two or three longitudinal, broadly arcuate branches, the first of which, arising near the middle of the proximal half of the tegmina, is very deeply forked. The externomedian vein is nearly straight and oblique, with two or three broadly arcuate longitudinal branches, simple or forked. The internomedian vein runs in a straight, oblique course, parallel to the last, to about the middle of the distal half of the tegmina, and has only four or five, mostly simple, arcuate, oblique branches, the area rapidly diminishing in diameter as the vein arises high up in the tegmina. The anal furrow is very strongly arcuate, rather sharply but very delicately incised, and terminates but little beyond the middle of the proximal half of the tegmina. The surface is black and shows no sign whatever of any cross lining.

Length of fragment, 11.5 mm.; probable length of tegmina, 15.4 mm.; breadth, 6.2 mm.

The single specimen shows but little more than half of one of the tegmina, with the shoulder, anal area, and a large part of the apex, with more than the distal half of both costal and inner margins, and, the under surface being exposed, is crossed by the veins of the overlying but imperfect hind wing. It comes from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and is from the collection of Mr. R. D. Lacoe, where it bears the number 2145*a*.

13. GERABLATTINA DEDUCTA sp. nov.

Pl. X, fig. 15.

The tegmina, as restored, are long elliptical, of very regular outline, probably tapering as much basally as apically, and about three times as long as broad. The costal margin, beyond the extreme basal narrowing of the tegmina (which is exceptionally great), is very gently and regularly arcuate; the other margins are lost in the only specimen known. The mediastinal vein extends to the end of the fragment and certainly to far beyond the middle of the distal half of the tegmina; it has half a dozen arcuate and rather long, simple or forked branches, and is itself rather far removed from the margin. The scapular vein probably terminates exactly at the apex of the tegmina, first forks at some distance before the middle, with two main stems of about equal value, the branches being nearly longitudinal and on the margin about seven or eight in number. The externomedian vein first branches about opposite the scapular vein, and has only two or three branches, but the first branch is compound, its branchlets divergent, so that it occupies a considerable space and probably sends at least half a dozen branchlets to the margin. The internomedian vein is regularly arcuate, and terminates before the middle of the distal half of the tegmina, and has only four or five simple, equidistant, gently arcuate branches. The anal furrow is very gently impressed, roundly bent well beyond the middle, and strikes the margin at the end of the proximal third of the tegmina. The surface is dark brown and everywhere shows delicate cross lines between the veins, very closely crowded and straight.

Length of fragment, 11 mm.; probable length of tegmina, 13.7 mm.; breadth, 4.5 mm.

The single specimen lacks the anal area, the apical sixth of the tegmina and most of the inner margin for a fifth the width of the tegmina. It comes from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and is in the collection of Mr. R. D. Lacoe, with the number 2146*a*.

14. GERABLATTINA SCAPULARIS.

Pl. X, fig. 7.

Gerablattina scapularis Scudd., Bull. U. S. Geol. Surv., No. 101, 19, pl. 2, fig. *l* (1893).

From the Lower (?) Productive Coal-measures of Pawtucket, R. I.

15. GERABLATTINA FRATERNA.

Pl. X, fig. 16.

Gerablattina fraterna Scudd., Bull. U. S. Geol. Surv., No. 101, 19–20, pl. 2, figs. *d*, *e* (1893).

From the Lower (?) Productive Coal-measures of Silver Spring, East Providence, R. I.

16. GERABLATTINA RADIATA sp. nov.

Pl. XI, fig. 1.

A single, nearly perfect fore wing, but with the tip destroyed. It is a little more than twice as long as broad, with widely radiating veins; the costal margin is strongly arcuate, especially on the proximal half, the inner margin nearly straight, and the tip probably roundly pointed. The mediastinal area extends almost to the end of the preserved portion and probably to the apical sixth of the tegmina, and the vein has few, remarkably longitudinal, mostly simple veins, though the middle ones arise from a longitudinal subbasal branch which simulates the main vein. The scapular vein is somewhat as in the genus Archimylacris, for it is strongly arcuate, throughout parallel with the costal margin, and terminates distinctly below the apex of the tegmina, though it apparently does not sweep upward at tip, to judge from the veins next the distal end of the specimen; it first forks at about the end of the proximal third of the tegmina, and has three or four longitudinal branches, simple, deeply forked, or compound. The externomedian vein, very strongly arcuate in the proximal third of the tegmina, is thereafter straight and has but three simple, subequidistant branches parallel to the main scapular vein, the first arising a little before the middle of the tegmina. The internomedian vein is straight beyond the proximal third of the tegmina and terminates only a little before the distal third of the same, with four straight oblique branches, the first very deeply forked, the others simple. The anal furrow is gently arcuate beyond the very strongly arcuate base and ends with the proximal third of the tegmina; the veins are few, simple, and bent arcuate. The veins are discolored with black on a blackish castaneous ground, and there is everywhere a feeble tracery of cross lines.

Length of fragment, 13.5 mm.; probable length of tegmina, 15.5 mm.; breadth, 6.75 mm.

This species is slenderer than those which here follow it, due to the tapering of the tegmina beyond the basal third, and is remarkable for the downward course of the scapular vein, which carries it below the apex of the tegmina.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2147*a*.

17. GERABLATTINA LATA sp. nov.

Pl. XI, fig. 2.

Represented by a single, almost perfect specimen of one of the tegmina; this is only twice as long as broad, of somewhat regular obovate form, the costal margin pretty regularly arcuate, the apex broadly rounded, the inner margin straight. The mediastinal area is tolerably broad and extends to beyond the middle of the apical third of the tegmina, tapering only in its extreme portion, where the mediastinal vein, hitherto parallel to the costal margin, curves rather strongly upward; the area is filled with simple or simply and not deeply forked, strongly oblique nervules, rather few in number but somewhat closely crowded by their obliquity. The scapular vein, first forking but little before the middle of the tegmina, is strongly sinuous, with four, at origin rather distant branches, which are arcuate and upcurved and mostly simple and closely crowded. The externomedian vein is even more strongly sinuous, with but three simple or forked branches, occupying on the apical margin from the extreme apex downward even less space than do the scapular nervules above the apex. The internomedian vein is similarly sinuous and parallel to the externomedian, and has seven generally simple, sometimes simply forked, oblique, nearly straight or gently arcuate branches, the area itself rapidly narrowing beyond the base. The anal area is very gently vaulted with a strongly impressed, arcuate, anal furrow, terminating at about the end of the basal two-fifths of the tegmina; the anal veins are few, distant, strongly arcuate, and subparallel to the anal furrow. The surface of the tegmina is uniformly piceous throughout, and well marked with pronounced but exceedingly delicate and closely crowded tremulous cross lines.

Length, 12.5 mm.; breadth, 6.25 mm.

Represented by one specimen from the Waynesburg coal (Lower Permian) of Cassville, W. Va., in the collection of Mr. R. D. Lacoe, bearing the number 2148*a*.

18. GERABLATTINA ROTUNDATA sp. nov.

Pl. XI, fig. 3.

This species, represented by a single specimen broken at base, closely resembles *G. lata* in general appearance, having precisely the same form except a straighter costal margin, and being of the same size. It is slightly more than twice as long as broad, with the costal margin straight in the middle half, the apex very broadly rounded, and the anal margin straight before the apical curve. The mediastinal vein is almost perfectly straight, so that the area is triangular and terminates barely before the middle of the distal half of the tegmina; the branches of the vein are rather few, mostly simple, straight and oblique. The scapular vein is gently sinuate and terminates exactly at the apex of the tegmina; it first forks just before the end of the proximal third of the tegmina, and by the middle of the tegmina has sent out three longitudinally oblique, simple, doubly forked, or compound branches, and itself forks once near the tip, so that nearly a dozen branches fall on the upper half of the rounded apical margin of the tegmina. The externomedian vein is similarly sinuate and emits three variably forked branches, farther from the base than the scapular branches, but nearly as numerous on the margin as they. Internomedian vein broadly arcuate but reaching out to the same distance as the mediastinal vein, with four or five simple, nearly straight, oblique branches, traced with exceptional fineness on the stone. Anal furrow not very deeply incised, straight beyond the arcuate basal portion, striking the margin not far before the middle of the tegmina; the anal area is obliterated. With the exception of the internomedian area, the veins are rather deeply incised and black, though not margined, and the whole of the surface of the tegmina is nearly black; there is a feeble sign or two of transverse cross lines in the apical part of the tegmina.

Length of tegmina, 10mm.; breadth, 4.9.

This species is readily distinguished from *G. lata*, its nearest ally, by the straight mediastinal vein and arcuate instead of sinuate internomedian vein.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe, No. 2149*a*.

19. GERABLATTINA OVATA sp. nov.

Pl. XI, fig. 4.

The only fragment preserved is broken at the base of the tegmina, but their shape can almost certainly be restored, showing them to have been of a very distinctly ovate form, about twice as long as broad, with the costal margin very regularly and rather strongly convex and the inner margin equally convex in the apical half, producing an ovate tip. The mediastinal vein is sinuous and terminates at about the middle of the apical half of the tegmina, is rather distant from the margin, and has but four or five simple or simply forked and rather long, rather oblique branches. The scapular vein is rather strongly sinuous, terminates barely above the apex of the tegmina, begins to fork at some distance before the middle of the tegmina, and has four simple, in one case deeply forked, nearly straight but slightly sinuous, oblique branches. The externomedian vein, beyond the arcuate base, is nearly straight, begins to fork at about the middle of the tegmina, and has four simple or medially forked, straight, longitudinal branches. The internomedian vein is parallel to the externomedian, and terminates in the middle of the apical two-fifths of the tegmina, with five straight or gently arcuate, oblique, distant branches, of very unequal length, since the area rapidly narrows from base to apex. Only a little of the anal furrow can be seen, but it plainly terminates but a little way before the middle of the inner border. The surface of the tegmina is uniform in coloring and transversely cross lined, as in the preceding species.

Length of fragment, 13.5 mm.; probable length of tegmina, 14.5 mm.; width, 7 mm.

This species is closely allied to *G. lata*, but is of a distinctly different form from the tapering of the apical half of the tegmina, which is scarcely in the least perceptible in the preceding species; the veins again are more longitudinal and less arcuate, and the neuration is also more scant.

The single specimen, represented by obverse and reverse, comes from the Waynesburg coal (Lower Permian) of Cassville, W. Va., and is in the collection of Mr. R. D. Lacoe, bearing the number 2150 *a–b*.

20. GERABLATTINA MINIMA sp. nov.

Pl. XI, fig. 5.

The tegmina would be pretty regularly elliptical in form were it not for the square shoulder formed by the anal area, but, disregarding that, would taper more apically than basally. The costal margin is very regularly and considerably arcuate, but more strongly at base than at apex; the inner margin is nearly straight to the middle of the distal half of the tegmina and then is as arcuate as the costal margin, forming a bluntly subacuminate tip; the tegmina are scarcely more than twice as long as broad and exceptionally small for a Paleozoic cockroach, being indeed the smallest known in this country, except one Permian species. The mediastinal area is of excessive breadth, reaching almost to the middle line of the tegmina, at its widest expansion; the vein is rather strongly sinuate and reaches almost to the middle of the distal fourth of the tegmina; its branches are subparallel, oblique, gently arcuate, generally simple but sometimes deeply forked, and about a dozen in number. The scapular vein is insignificant and closely parallel to the mediastinal vein; it forks only just before the middle of the distal half of the tegmina and has but two simple branches, occupying on the margin only half the narrow space lying between the end of the mediastinal area and the extreme apex of the tegmina. The externomedian vein is also sinuate in the same sense, first forks at about the middle of the tegmina, and has only three simple or forked branches, widely separated at base. The internomedian vein is compound; its principal portion is nearly straight, but at the middle of the tegmina it has a superior apically forked branch which extends its area farther out than the mediastinal area, the main stem having half a dozen rather distant, parallel, transversely oblique, nearly straight, constantly shortening branches. The anal furrow is distinctly impressed, but more by the moderate vaulting of the anal area than by its own incision, is very strongly and regularly arcuate, and strikes the margin at about the distal end of the second fifth of the tegmina; the anal veins are numerous, closely crowded, subsinuate, parallel, longitudinally oblique and mostly simple. The surface of the tegmina is black and in places, particularly in the internomedian area, there are the feeblest possible traces of excessively fine and closely crowded straight cross lines.

Length of tegmina, 9.75 mm.; breadth, 4.7 mm.

This species is most nearly allied to *G. ovata*, but the shape of the tegmina and the relative importance of the mediastinal and internomedian areas are very different.

The single specimen known, with its reverse, is completely preserved, and was obtained by myself in the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Nos. 2183 and 2184, United States Geological Survey.

21. GERABLATTINA FASCIGERA.

Blattina fascigera Scudd., Proc. Bost. Soc. Nat. Hist., XIX, 238–239 (1878).
Gerablattina fascigera Scudd., Mem. Bost. Soc. Nat. Hist., III, 113–115, pl. 6, figs 1 2 (1879); Foss. Ins. N. A., I, 133–135, pl. 6, figs. 1, 2 (1890).

This is the oldest known Paleozoic cockroach.

From the Interconglomerate or Millstone Grit of Campbell's Ledge, near Pittston, Pa.

11. Genus ANTHRACOBLATTINA.

Anthracoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 87–88 (1879); Foss. Ins. N. A., I, 107–108 (1890).

This is rather a characteristic European type of Blattinariæ, for it there holds a second place, while of the fourteen known species only two are American. The geologic range is the same in the two countries, and though in Europe it culminates toward the close of the Carboniferous period, the culmination is in no sense striking, as it is in some genera. In our own country one of the species occurs in the

Lowest Productive Coal-measures of the Western Interior coal-basin in Missouri, the other in the Permian of West Virginia. The genus has not before been recognized in America.

Table of the species of Anthracoblattina.

Large species, the tegmina exceeding 25 mm. in length; scapular vein first forking far earlier than the externomedian .... 1. *A. americana.*
Small species, the tegmina less than 12 mm. in length; scapular and externomedian veins first forking at about the same distance from the base.... 2. *A. virginiensis.*

1. ANTHRACOBLATTINA AMERICANA sp. nov.

Pl. XI, fig. 7.

The basal half or thereabouts of a large fore wing represents apparently a species of Anthracoblattina, a genus hitherto unknown in America; the form of the tegmina can, of course, not be told with certainty, but I have attempted to restore the probable outline from the curves of that portion of the costal and inner margins which is preserved and from the course of the principal veins. The tegmina are broad with a broad well-rounded shoulder and a gently arcuate costal and nearly straight inner margin; they are probably a little more than twice as long as broad, and the broadest portion is a little beyond the middle of the anal area. The mediastinal area is remarkably broad, occupying at the base of the wing fully one-half its width, narrowing at first, afterwards remaining nearly equal to a little before the middle of the wing, when it tapers somewhat rapidly, and probably terminates at the end of the middle third of the tegmina, the vein having thus a broadly sinuous course, and throwing off at regular intervals a series (four or five are visible) of long, straight, simple, oblique branches. The scapular vein runs at the extreme base as close as possible beside the externomedian vein, parts from it before the middle of the anal area, and thereafter runs at first parallel to the costal margin; it sends off its first branch before the end of the basal third of the tegmina, its second a little before the middle of the tegmina, the first forking before the origin of the second branch; more than this can not certainly be said from the imperfect nature of the fragment, but it would appear from the course of the veins beside it that it occupies on the costal margin all the portion lying between the mediastinal area and the extreme tip of the tegmina. The externomedian vein is strongly arcuate and first forks opposite the first fork of the first branch of the scapular vein, and from its course and that of the adjoining veins it apparently forks longitudinally in the apical half of the tegmina and occupies on the margin a space considerably less than that of the scapular vein. The internomedian vein runs exactly parallel to the externomedian, and apparently terminates somewhat beyond the middle of the outer half of the tegmina; in the portion which remains it emits two compound, gently arcuate branches, each of them forking doubly before the middle of the tegmina. The anal furrow is deeply and sharply impressed, very strongly arcuate, almost bent at right angles in its proximal half, beyond nearly straight, terminating on the margin just beyond the basal third of the tegmina; the anal area is occupied by but few veins and these at considerable distance from the anal furrow; they are forked or doubly forked, and run in a longitudinally oblique direction, that nearest the anal furrow passing a little above the middle of the area and somewhat arcuate in the same sense as the anal furrow.

Length of fragment, 15.5 mm.; probable length of tegmina, 30 mm.; breadth, 14.5 mm.

The extreme width of the mediastinal area separates this at once from any of the European species of Anthracoblattina.

From a coal bank near Clinton, Mo., belonging to the Lowest Productive Coal-measures. Mr. R. D. Lacoe; one specimen, No. 2137*a*.

2. ANTHRACOBLATTINA VIRGINIENSIS.

Pl. XI, fig. 8.

A nearly perfect fore wing represents a second species, remarkable for the brevity of the internomedian area; the tegmina are smaller and stouter than usual in this genus, being but little more than twice as long as broad, obovate, probably with broadly rounded apex; the costal margin is scarcely arcuate except at the extremities. The mediastinal area is distinctly less than one-third the breadth of the tegmina, at first equal, but gradually approaching the margin in its distal half by the arcuation of the main vein, which reaches the border just before the middle of the distal half of the tegmina; there are about five longitudinally oblique, generally simple, nearly straight branches. The scapular vein is broadly sinuous, being at the base strongly, at the apex feebly, arcuate, terminating at the apex of the tegmina; it first forks well before the middle of the tegmina and has about four mostly deeply forked, feebly arcuate branches, which have much the direction of those of the mediastinal area. The externomedian vein forks fully as soon as the scapular vein and has more branches, the first of which is compound (the others not fully preserved). The internomedian area is exceptionally short for an Anthracoblattina, the main vein being rather strongly arcuate and terminating not far beyond the middle of the tegmina; it has four gently arcuate mostly simple branches. The anal furrow is strongly and very regularly arcuate, not very deeply impressed, and terminates not far from the end of the proximal third of the tegmina; the anal area is not preserved and the other parts of the immediate base are destroyed. The surface of the tegmina is finely, but not very closely, cross-lined, except in the internomedian and the basal portion of the externomedian area, where it is irregularly and not very delicately reticulate.

Length of fragment, 10.5 mm.; probable length of tegmina, 12 mm.; breadth, 5.4 mm.

This species differs from the European species, but perhaps to a less extent from the single other American species, in the brevity of the internomedian area. It is the smallest species of the genus, which contains some of the largest of Paleozoic cockroaches, but it is not much smaller than the European *A. remigii*, from Cusel.

From the Waynesburg coal (Lower Permian), of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2138 *a–b*.

12. Genus HERMATOBLATTINA.

Hermatoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 115 (1879); Foss. Ins. N. A., I, 135 (1890).

This genus was founded upon a couple of species from the Coal-measures of Germany, and one has since been added from the Scottish coal field. It seems to be confined to the uppermost Carboniferous beds and the Permian. No American species have yet been detected.

13. Genus PROGONOBLATTINA.

Progonoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 118–119 (1879); Foss. Ins. N. A., I, 138–139 (1890).

This genus was founded upon a couple of European species, one occurring at the very top of the Carboniferous series in Germany, the other lower down, but in the Productive Coal-measures of Switzerland. None have since been added in Europe, and until now none have been found in America, but we are here able to add a representative from this country. It comes from the Lowest Productive Coal-measures of the Eastern Interior coal field in Illinois. The American species, however, departs less widely than the European from the other Palæoblattariæ in the more normal extent of the internomedian area, which here reaches to the distal end of the middle third of the tegima.

PROGONOBLATTINA COLUMBIANA.

Pl. XI, fig. 9.

The tegmina are of a graceful form, very elongate oval, but with the inner side for the greater part straight, broadest at the end of the proximal third, tapering gradually to a rounded, scarcely pointed apex; both tegmina are perfectly preserved, but the neuration of one is partly lost in unimportant places; the breadth is to the length about as 1 : 2.6. The costal margin is very regularly and considerably arcuate, the base ovately rounded and the inner margin straight for two-thirds the length of the tegmina, unaffected by the anal area. The mediastinal area is vittate, the vein extending slightly beyond the middle of the tegmina and the seven or more branches mostly simple, but sometimes deeply forked, increasingly oblique distally. The scapular vein is strongly and pretty uniformly sinuous, terminating just above the apex of the tegmina; on one wing it begins to branch far toward the base of the tegmina as in the other species of the genus, but on the other it does not branch until about the end of the proximal third of the tegmina; yet in the former case, the right side, the vein is much less numerously branched than in the other, although at the same time more strongly sinuous, permitting by its recession from the margin space for a larger number of offshoots; but on this side, as also in the other species of Progonoblattina, the branches are more nearly longitudinal, by which they are reduced in number; on the left fore wing, on the contrary, they are decidedly oblique and excepting the compound basal branch are all simple. The main course of the externomedian vein is, of course, that of the preceding; it first branches not far from the middle of the tegmina, its branches slightly arcuate and nearly longitudinal, the first compound, the others simple. The internomedian vein is regularly and gently arcuate throughout, terminating at about the distal end of the middle third of the tegmina, and has five subequidistant, nearly straight, oblique branches. The anal furrow is strongly and regularly arcuate, deeply impressed, especially toward the base, and strikes the margin a little beyond the end of the proximal third of the tegmina; the half dozen anal veins are simple, arcuate, subequidistant, parallel.

The pronotal shield is also preserved, slightly distorted by pressure. It was apparently subtruncate at base, less than twice as broad as long, strongly convex in front; it appears also to have been considerably vaulted and to have had a large discal, transverse, quadratic impression, nearly twice as broad as long, and there is also trace of a fine margination around all but the base.

The impression of some of the legs, and especially of the hind pair, appears, but only enough to say that they were slender and of a normal length.

Length from front of prothorax to tip of closed tegmina, 26 mm.; of tegmina, 20.75 mm.; breadth of same, 8 mm.; of overlapping tegmina, 14.25 mm.; of prothorax, 9.75 mm.; length of hind femora, 6.5 mm.; breadth of same, 1.75 mm.; length of hind tibia, 4.5 mm.; of tarsi, 6.5 mm.

The single specimen known lies in a natural position, with all the exposed parts preserved, and occurs with its reverse in the center of a nodule from the Lowest Productive Coal-measures of Mazon Creek, Illinois. It was received for study from Mr. William Gurley.

14. Genus ORYCTOBLATTINA.

Oryctoblattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 121-122 (1879); Foss. Ins. N. A., I, 141-142 (1890).

Five species of this genus are now known—three from Europe and two from North America. The European species are found in later rocks than the American, one occurring in Dyassic, the other two in Upper Carboniferous deposits. One of our two species, indeed, is found in the Barren Coal-measures of the Western Interior coal basin, in Missouri, but the other in the Lowest Productive Coal-measures of the Eastern Interior coal basin in northern Illinois. The type is a very peculiar one, and the resemblance of one of our species (the younger) to the European is very striking, although it is still very clearly distinct; it comes also from a similar horizon.

Table of the species of Oryctoblattina.

Scapular vein with its first branch running close and parallel to the mediastinal throughout.. 1. *O. occidua.*

Scapular vein before branching diverging widely from the mediastinal, only its first branch subparallel to the mediastinal.............................. 2. *O. laqueata.*

1. ORYCTOBLATTINA OCCIDUA.

Oryctoblattina occidua Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 37 (1885); Mem. Bost. Soc. Nat. Hist., IV, 414-415, pl. 32, fig. 3 (1890); Foss. Ins. N. A., I, 390-391, pl. 24, fig. 3 (1890).

Lowest Productive Coal-measures of Mazon Creek, Illinois.

2. ORYCTOBLATTINA LAQUEATA sp. nov.

Pl. XI, fig. 6.

Tegmina only. The tegmina are of an elongate oval form, broadest at the end of the basal third, considerably less than three times as long as broad; the costal margin is strongly arcuate, especially at base, the inner margin gently arcuate, the apex, which is broken, evidently falling about the middle line, perhaps a little below it. The mediastinal vein runs at no great distance from the margin, subparallel to it but gradually approaching it, at last somewhat abruptly, and terminates just beyond the middle of the tegmina; it has many simple, straight, slightly oblique branches, those in the basal half interrupted by a series of connecting cross veins which disturb their regularity. The scapular vein starts in close proximity to the mediastinal in the basal fourth, diverges rapidly from it and thereafter runs at a wide distance from but subparallel to it, terminating a little less than midway between the tip of the mediastinal vein and the apex of the tegmina, and in this last portion of its course, from just before the tip of the mediastinal vein, sends to the border numerous very crowded, straight, oblique, simple veins; just beyond its change of course the scapular vein throws off a principal branch, which emits several inferior nervules at rather wide distances apart toward the apex of the tegmina; most of these branches are simple for the greater portion of their course, or they may be deeply forked, so that eight or nine nervules strike the margin; besides this, in the interspace between the main vein and its principal branch, there is thrown off from the upper side of the principal branch a short, widely diverging vein. The externomedian vein runs in a nearly straight, gently sinuate course at no great distance from the scapular vein and its lowest branch to the inner margin, at no great distance before the tip; it has but a single branch, originating opposite the first furcation of the principal mediastinal branch, but at its origin obscured by the reticulation of the tegmina and distinct only beyond the middle of the wing, at which it divides into two distally branching veins. The internomedian vein forks close to the base, its lower branch simple, straight, and running in close proximity to the anal furrow, its upper branch forking widely opposite the tip of the former; the space upon the margin between its forks as well as between these and the lower branch is filled with numerous oblique, straight, closely crowded branches similar to the upper branches of the main scapular stem. The anal furrow is sharply but not deeply impressed, gently arcuate at the base, beyond nearly straight; of the anal veins only a pair can be seen, parallel to the anal furrow and not closely crowded. The whole surface is covered with a minute but sharp reticulation of cross veins forming cells which are generally polygonal, but, by reason of the direct or nearly direct transversality of the cross veins, mostly quadrilateral in the scapular and anal areas and between the scapular and mediastinal veins, except in the interspaces between the straight, closely crowded, marginal branches of both the costal and inner borders, which are free.

This species is remarkably similar to and yet very distinct from *O. reticulata* of the German coal, and is another remarkable instance of the similarity of many forms in the European and American Coal-measures. The general resemblance is most striking, due to the sharp and minute reticulation of the tegmina, the multiplicity of the short branches which crowd the margin in certain spots, and the general form and relative importance of the scapular vein, with its branches almost wholly dependent on not the main vein but its principal branch. It differs in the very different form of the tegmina, the lack of an independent curve to the anal area, and in the wide basal branching of the internomedian vein. As will be seen, *O. laqueata* bears a much stronger resemblance to the European species than to *O. occidua*, the only American species hitherto known.

Length of fragment, extreme tip and base being lost, 17.5 mm.; probable length of wing, 21 mm.; breadth, 7.5 mm.

The single specimen, from the Coal-measures of Kansas City, Mo., was collected by Mr. Sidney J. Hare about 170 feet above the base of the Upper Barren Coal-measures, and is in the collection of Mr. R. D. Lacoe, under the number 2136*a*.

15. Genus POROBLATTINA.

Poroblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 38–39 (1885).

First described from the Triassic rocks of Colorado, where three species occur; it has now been found, not only in the Permian of West Virginia, where three more species are found, but even in the Barren Coal-measures of eastern Ohio, in which two other species are recognized, or eight species in all. It thus ranges from the Barren Coal-measures to the Trias, and, as far as yet appears, is an exclusively American type.

Table of the species of Poroblattina.

a^1. Mediastinal area extending well beyond the middle of the tegmina; externomedian vein first forked beyond the extremity of the anal furrow.
  b^1. Externomedian vein simple, or, if forked, divided only at extreme tip. 1. *P. longinqua.*
  b^2. Externomedian vein more or less and deeply forked.
    c^1. Scapular vein terminating at or above the tip of the tegmina; internomedian vein and branches oblique and nearly straight.
      d^1. Mediastinal area narrowing only near extremity, which reaches far beyond the middle of the distal half of the tegmina; scapular vein sinuous, its branches almost longitudinal .... 2. *P. gratiosa.*
      d^2. Mediastinal area narrowing throughout distal half and reaching only to middle of distal half of tegmina; scapular area arcuate, its branches distinctly oblique .... 3. *P. fossa.*
    c^2. Scapular vein terminating below the tip of the tegmina; internomedian vein and branches strongly arcuate .... 4. *P. meieri.*
a^2. Mediastinal area terminating distinctly short of the middle of the tegmina; externomedian vein first forked opposite the extremity of the anal furrow.
  b^1. Scapular vein strongly sinuous, the proximal series of branches simple. 5. *P. arcuata.*
  b^2. Scapular vein gently sinuous, the proximal series of branches deeply forked.
    c^1. Externomedian vein with few, distant, and simple branches.
      d^1. Internomedian vein long, with numerous but distant branches. 6. *P. lakesii.*
      d^2. Internomedian vein short, with very few branches .... 7. *P. ohioensis.*
    c^2. Externomedian vein with numerous, crowded, and often forked branches. 8. *P. complexinervis.*

1. POROBLATTINA LONGINQUA.

Pl. XI, fig. 12.

Although the single specimen at hand is very fragmentary and scarcely shows a natural border at any point, the portion preserved shows the larger part of the neuration and its most essential features, which are somewhat strikingly different from those of any other species. Apparently the tegmina were of a slender ovate form, about two and a half times longer than broad, though this is conjectural. The mediastinal area is vittate and rather narrow, the vein with rather distant gently arcuate simple branches, and evidently ends well beyond the middle of the tegmina. The scapular vein is gently and very broadly sinuous, and retreats so from the costal margin as probably to terminate at some considerable distance below the apex of the tegmina, which is one of its striking peculiarities; it first forks a little before a point opposite the extremity of the anal furrow, and in the fragment has but two branches, both of which are or must be forked if not compound, and probably a third branch arises at a long distance from the second; all these branches are very longitudinally oblique. The externomedian vein is simple as far as it can be traced, which is through at least three-fourths of its course; it runs in a sinuous course, midway between and distant from the adjacent veins. The internomedian vein is similarly sinuous, and in the preserved portion has three (probably there are in all four or five) nearly straight and oblique distant branches. The anal furrow is feebly incised, arcuate, and scarcely bent in the middle, and terminates probably well beyond the middle third of the tegmina; anal veins not preserved. The internomedian veins are very delicate, the others rather coarse, and all are broadly bordered on each side with carbonaceous black, which in the internomedian area shows traces of delicate cross lines.

Length of fragment, 15 mm.; probable length of tegmina, 22 mm.; breadth, 8.5 mm.

In the simple or only apically forked externomedian vein and the downward embrasive sweep of the scapular vein, including the whole apex of the tegmina, this species differs strikingly from all its allies.

From the Lower Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, No. 111.

2. POROBLATTINA GRATIOSA.

Pl. XI, fig. 13.

The tegmina, in the single instance known nearly complete, hardly taper apically, but are slender, being fully two and one-half times longer than broad, the costal margin rather gently arcuate, the inner margin straight, the apex probably well rounded. The mediastinal area is vittate and tolerably broad, extending to not very far short of the apex of the tegmina; the vein has seven or eight similar, simple, strongly oblique, nearly straight branches. The scapular vein is somewhat sinuate and terminates at the very apex of the tegmina; it branches early, well before the tip of the anal furrow and within the proximal fourth of the tegmina; in all there are about five feebly arcuate, longitudinal, mostly simple branches, arising at somewhat unequal distances apart. The externomedian vein is very feebly sinuous, longitudinally oblique, with three straight, simple or forked, very longitudinally oblique branches arising at very unequal distances apart, the earliest a little beyond the tip of the anal furrow. The internomedian vein is very broadly arcuate (too straight in the figure) and ends before the middle of the distal half of the tegmina, and has but three nearly straight, oblique, simple or simply forked branches. The anal furrow is lightly impressed, rather regularly and rather strongly arcuate, ending on the margin not a great way beyond the proximal fourth of the tegmina; anal area lost. The entire surface is uniformly carbonaceous black and marked with exceedingly delicate, closely crowded cross lines.

Length of fragment, 11 mm.; probable length of tegmina, 13.5 mm.; breadth, 5 mm.

The great length of the mediastinal area and the infrequent branching of the scapular and externomedian veins distinguish this species from *P. fossa*, its nearest ally. Its most striking peculiarity is the behavior of the externomedian vein.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2134 *a–b*.

3. POROBLATTINA FOSSA.

Pl. XI, fig. 15.

Tegmina oblong ovate in form, much more than two and one-half times longer than broad, with regularly and considerably arcuate costal margin and nearly straight inner margin. The mediastinal vein is nearly straight, with a very gentle arcuation beyond the base, and reaches nearly to the distal end of the middle third of the tegmina; its branches are straight, simple, and very longitudinally oblique. Beyond the base the scapular vein is gently and broadly arcuate, striking the apex of the tegmina; it first branches within the proximal third of the tegmina, the branch doubly forked, and thereafter, about the middle of the tegmina, has three more simple or forked branches, all parallel to those of the mediastinal area. Beyond the base the externomedian vein is straight and oblique, with three or four forked or doubly forked longitudinal branches, the first thrown off at some distance beyond the origin of the first scapular branch. The internomedian vein, beyond its gently arcuate base, is straight, parallel to the internomedian vein, and strikes the margin at the distal end of the middle fifth of the tegmina; it has four or five straight, oblique, simple branches, the first sometimes forked. The anal furrow is regularly and considerably arcuate, but little impressed, and strikes the margin at about the end of the proximal third of the tegmina; anal area not preserved. The internomedian veins are lightly impressed and delicate, the others rather deeply and coarsely; the surface is uniformly blackish, and there is no trace of marking or other sculpture.

Length of better fragment, 14 mm.; probable length of tegmina, 16.5 mm.; breadth, 6 mm.

This species is most nearly allied to the preceding, from which it differs in the form and length of the mediastinal area, the more oblique and numerous scapular veins, the more strongly convex costal margin, and probably in the form of the apex of the tegmina.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; two specimens, Nos. 2083 *a–b*, *c*.

4. POROBLATTINA MEIERI.

Petrablattina meieri Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 38 (1885); Mem. Bost. Soc. Nat. Hist., IV, 465, pl. 42, fig. 17[1] (1890); Foss. Ins. N. A., I, 441, pl. 34, fig. 17[1] (1890).

This species was wrongly referred by me to Petrablattina.

Triassic of Fair Play, Colo.

5. POROBLATTINA ARCUATA.

Poroblattina arcuata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 39 (1885); Mem. Bost. Soc. Nat. Hist., IV, 466, pl. 41, fig. 5 (1890); Foss. Ins. N. A., I, 442, pl. 33, fig. 5 (1890).

Triassic of Fair Play, Colo.

6. POROBLATTINA LAKESII.

Poroblattina lakesii Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 39 (1885); Mem. Bost. Soc. Nat. Hist., IV, 466, pl. 41, fig. 11 (1890); Foss. Ins. N. A., I, 442, pl. 33, fig. 11 (1890).

Triassic of Fair Play, Colo.

7. POROBLATTINA OHIOENSIS.

Pl. XI, fig. 11.

The apical third or more of the only specimen known is unfortunately lost, but the tegmina are very slender and must have been more than three times as long as broad; the costal margin is very slightly arcuate beyond the base and the inner margin straight, so that the tegmina taper very slightly and probably had a well-rounded apex. The mediastinal area is very brief and narrow and the main vein very slightly arcuate, ending but a little beyond the proximal third of the tegmina, with three or four longitudinally oblique, simple, and straight branches. The scapular is far the most important of the veins, with a sinuous course through the middle of the tegmina, terminating at the apex; it sends out a large number of branches, not very crowded, either simple or deeply forked, occasionally doubly forked, the first of which is emitted far toward the base of the tegmina or about opposite the middle of the anal area; the branches are more or less arcuate and oblique. The externomedian vein is broadly sinuous and oblique, and in the part preserved shows but two branches, which are simple, but in all probability they fork in the apical portion, as there is abundant room for it. The internomedian vein runs parallel to the externomedian and strikes the inner margin not far from the middle of the tegmina; it is badly preserved and remarkably insignificant, but probably has one or two short oblique branches. The anal furrow is deeply impressed at base, but beyond only delicately incised, pretty regularly and not very strongly arcuate, and strikes the inner margin beyond the proximal third of the tegmina; the anal veins that can be seen in the portion most removed from the furrow are arcuate in a sense the reverse of that of the furrow, closely crowded, and most of them deeply forked. The scapular veins are as deeply incised as the anal furrow; the others are more delicate; the whole surface is black, and there is no sign of cross lining.

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[1] Erroneously marked 13 on plate. See note on p. 87.

Length of fragment, 7.5.mm.; probable length of tegmina, 11 mm.; breadth at tip of anal furrow, 3.5 mm.

The tegmina are peculiar for the insignificance of the internomedian area and the contrast between the two lateral halves, as to the number and prominence of the nervules. It bears no special resemblance to any of the others.

From the Barren Coal-measures of Ohio, less than 100 feet above the crinoidal limestone, in the valley of Wills Creek, Richmond, Jefferson County. Mr. S. Huston; one specimen, No. 162.

8. POROBLATTINA COMPLEXINERVIS.

Pl. XI, fig. 14.

The last species of Poroblattina is represented by a single specimen of one of the tegmina, perfect in every part excepting insignificant fractures from the base and tip. The tegmina are of a very graceful subovate form, with well rounded outlines, nearly two and three-quarters times as long as broad; the costal margin is considerably and very regularly convex, the inner margin straight except at base and tip, the apex well rounded and subacuminate; the tegmina are crowded with nervures. The mediastinal area is short and narrow, terminating at the distal end of the second fifth of the tegmina, the vein with four or five oblique simple branches. The scapular vein is broadly and gently sinuous, terminating a little above the apex, with six or seven tolerably straight, oblique, generally forked branches, arising subequidistantly, the earliest about opposite the middle of the anal area. The externomedian vein is very peculiar; simple and arcuate until beyond the tip of the anal area, it appears here to throw off numerous branches on each side as it runs toward a point as far below the apex as the tip of the scapular vein is above it; but in reality it runs parallel to the internomedian vein (as in the other species of the genus), while one of its middle branches is complexly compound, spreading fan-shaped with numerous offshoots filling the lower apical portion of the tegmina, the other branches before and after it being usually simply forked. The internomedian vein is broadly arcuate, though nearly straight in its middle half, and terminates somewhat beyond the middle of the tegmina; it has a number of feebly sinuous, straight and oblique, crowded branches. The anal furrow is deeply impressed, at least at base, and strongly arcuate, terminating on the inner margin scarcely beyond the proximal third of the tegmina; the anal veins are very numerous, mostly simple and arcuate, less so and more crowded away from the anal furrow. The anal and internomedian veins are delicately traced, the others more pronounced; the whole surface is carbonaceous black, and shows nowhere any sign of cross lines.

Length of tegmina, 16.75 mm.; breadth, 6.25 mm.

This species resembles the Triassic species more than do any of the other Paleozoic forms, but it differs widely from them and indeed from all the others in the crowded venation, and in the complicated distribution of the externomedian branches.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2135 *a–b*.

16. Genus PETRABLATTINA.

Petrablattina Scudd., Mem. Bost. Soc. Nat. Hist., III, 123–124 (1879); Foss. Ins. N. A., I, 143–144 (1890).

This is a second genus found both in Paleozoic and Mesozoic rocks. One Triassic species formerly referred here really belongs in Poroblattina (*P. meieri*), but *Petrabl. æqua* from the same rocks undoubtedly belongs here. One of the other two American species, like the single European species, occurs in the Permian (of West Virginia); the other, on the contrary, is a far older form, coming from probably the Lowest Productive Coal-measures in the Acadian coal basin, near the upper limit of the Millstone Grit.

Table of the species of Petrablattina.

a^1. Mediastinal area reaching much beyond the middle of the tegmina; internomedian area wholly within the basal half of the tegmina......... 1. *P. sepulta.*

a^2. Mediastinal area reaching scarcely or not beyond the middle of the tegmina; internomedian area extending more or less into the distal half of the tegmina.

  b^1. Scapular vein terminating at the tip of the tegmina; internomedian area reaching but little beyond the middle of the tegmina .... 2. *P. hastata.*

  b^2. Scapular vein terminating far before the tip of the tegmina; internomedian area reaching well beyond the middle of the tegmina........... 3. *P. æqua.*

1. PETRABLATTINA SEPULTA.

Blattina sepulta Scudd., Proc. Amer. Assoc. Adv. Sc., XXIV, B, 111, fig. 2 (1876); Can. Nat., n. s., VIII, 89–90, fig. 2 [1] (1876).

Petrablattina sepulta Scudd., Mem. Bost. Soc. Nat. Hist., III, 125–126, pl. 6, fig. 7 (1879); Foss. Ins. N. A., I, 145–146, pl. 6, fig. 7 (1890).

From the very Lowest Productive Coal-measures of Sydney, Cape *Breton Island.*

2. PETRABLATTINA HASTATA.

Pl. XI, fig. 10.

The tegmina are of a subtriangular shape, about two and one-half times longer than broad, tapering rather rapidly almost from the base, the costal margin gently convex, the inner margin nearly straight. The apex is broken in the only specimen seen, but must have been more or less pointed, and probably rounded as represented in the figure. The mediastinal area is moderately broad and short, not extending to the middle of the tegmina, with five or six mostly simple, nearly straight, oblique branches. The scapular vein is broadly sinuous, running beyond the proximal third of the tegmina, through the middle of the same, and terminating at or scarcely above the apex; it branches early, before the end of the proximai third of the tegmina, the first branch simple, the others compound or forked, so that probably ten or twelve nervules strike the margin, and all are nearly longitudinal. The externomedian vein is strongly and pretty regularly arcuate, striking the inner margin scarcely beyond a point opposite the tip of the mediastinal vein, and having three simple or apically forked branches which are nearly longitudinal, but descend slightly toward the inner margin, the proximal branch arising well beyond the middle of the vein. The internomedian vein is parallel to the externomedian and has but two forked and arcuate branches. The anal furrow is similarly arcuate, rather deeply impressed, and strikes the margin a little beyond a point opposite the first branching of the scapular vein; the anal veins are numerous and rather deeply forked, more closely crowded proximally than distally, and, from forking, more crowded next the margin than away from it. The internomedian and anal veins, and especially the former, are very delicately traced, while the others are rather heavily impressed; the whole surface is uniformly coal black, and there is no trace of other sculpture than the venation.

Length of fragment, 6.5 mm.; probable length of tegmina, 8.25 mm.; breadth at end of anal furrow, 3.5 mm.

In the form of the tegmina *P. hastata* differs decidedly from either of the other species of the genus, but in its neuration it agrees better with the Carboniferous than with the Triassic species; all three species are widely different. It is the smallest Paleozoic cockroach known from this country.

From the Waynesburg coal (Lower Permian) of Cassville, W. Va. Mr. R. D. Lacoe; one specimen, No. 2133 *a–b*.

3. PETRABLATTINA ÆQUA.

Petrablattina æqua Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 38 (1885); Mem. Bost.[1] Soc. Nat. Hist., IV, 465, pl. 42, fig. 13[1] (1890); Foss. Ins. N. A., I, 441, pl. 34, fig. 13. (1890).

Trias of Fair Play, Colo.

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[1] Erroneously marked 9 on the plate. See note to p. 87.

Genus LEPTOBLATTINA.

Leptoblattina Woodw., Geol. Mag., Dec. iii, Vol. IV, 58 (1887).

This is an exclusively European type of cockroach. Two species are known, one from the very oldest true Coal-measures, the other possibly from the same or slightly younger rocks.

DESCRIPTION OF THE HIND-WING OF A GIGANTIC SPECIES.

BLATTINA sp.

Pl. X, fig. 16.

A single specimen of a hind wing of enormous size differs so much from any other known that I use for it, as a convenience merely, the old generic term Blattina, as applied to fossil cockroaches in general. It is nearly complete, and shows that the costal margin was gently and nearly uniformly arcuate, the inner margin very strongly and probably uniformly arcuate, the apex falling scarcely below the middle of the upper half of the wing and subacuminate but well rounded. The mediastinal vein is straight, runs very near to and parallel with the margin, and terminates almost at the distal end of the middle third of the wing; the area is broken so that only a couple of apical branches can be seen. The scapular vein is almost rigidly straight and terminates at some distance below the extreme apex of the wing, divides at the very root into two main branches which again fork in the basal fourth of the wing; the branchlets of both are superior, those of the upper stem much the more numerous and often compound, those of the lower feeding that part of of the margin lying below the apex and all longitudinal, those of the upper stem apically arcuate, especially in their terminal members. The externomedian vein is straight and runs through nearly the middle line of the wing, gradually passing into the lower half by its divergence from the scapular, first forks at about the end of the proximal third of the wing, and thereafter sends out arcuate sublongitudinal offshoots on either side indiscriminately, which do not fork before their middle. The internomedian vein is bent-arcuate, subparallel to the externomedian before that forks, is then bent, and ends a very little farther out than the mediastinal vein; it has only a couple of very oblique branches, the the distal one twice deeply forked. No anal veins can be traced. The interspaces near the apex show a somewhat irregular tremulous cross lining, not very crowded.

Length of fragment, 47 mm.; probable length of entire wing, 51 mm.; breadth of fragment, 24.5 mm.; probable complete breadth, 25.25 mm.

The complete correspondence of the long mediastinal area in this wing to that of Etoblattina in the few examples known, and the strong probability that the area in question will be found to be very short and perhaps triangular in the Mylacridæ, lead me to believe that this wing should be referred to the Blattinariæ and not to the Mylacridæ. Its excessive size, which shows it to belong to one of the largest fossil cockroaches yet discovered, would at first seem to recall the Mylacridæ, but it should not be forgotten that some species of Etoblattina, such as *E. didyma* and notably *E. illustris*, rival the largest Mylacridæ known. The only two species of Etoblattina known from the same fauna as this wing are of only about one-half its size. It plainly, therefore, belongs to a species, the tegmina of which are yet undescribed. Its variance from what we know of the hind wings of Etoblattina, however, prevent our placing it, at least for the present, in that genus, and it seems best to refer it simply to "Blattina," as a "magazine" genus.

From the Lowest Productive Coal-measures of Mazon Creek, Illinois. Mr. R. D. Lacoe, No. 2038*a*.

NEOBLATTARIÆ

With a few Triassic exceptions, this division embraces all the cockroaches which are known from later than Paleozoic times.

17. Genus NEORTHROBLATTINA.

Neorthroblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 108–109 (1885).

A genus confined, as far as known, to the Triassic rocks. Four species have been found in central Colorado.

Table of the species of Neorthroblattina.

a^1. Fore wings not more than two and one-half times as long as broad; mediastino-scapular vein terminating only a little before the tip of the tegmina.
  b^1. Internomedian vein beginning to fork long before the externomedian and of equal importance with it .... 1. *N. albolineata.*
  b^2. Internomedian vein beginning to fork scarcely or not before the externomedian and of less importance than it.
    c^1. Internomedian area terminating much farther from the apex of the tegmina than the mediastino-scapular .... 2. *N. lakesii.*
    c^2. Internomedian area reaching out toward the apex of the tegmina nearly as far as the mediastino-scapular .... 3. *N. rotundata.*
a^2. Fore wings about three times as long as broad; mediastino-scapular area terminating long before the tip of the tegmina............... 4. *N. attenuata.*

1. NEORTHROBLATTINA ALBOLINEATA.

Neorthroblattina albolineata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 109 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, pl. 42, figs. 2, 18 (1890); Foss. Ins. N. A., I, 336, 443, pl. 34, figs. 2, 18 (1890).

Triassic of Fair Play, Colo.

2. NEORTHROBLATTINA LAKESII.

Neorthroblattina lakesii Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 109 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, 468, pl. 42, figs. 9, 15[1] (1890); Foss. Ins. N. A., I, 336, 443, 444, pl. 34, figs. 9, 15[1] (1890).

Triassic of Fair Play, Colo.

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[1] *Erroneously marked* 10 and 16 on plate. See note on p. 87.

3. NEORTHROBLATTINA ROTUNDATA.

Neorthroblattina rotundata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 109–110 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, 468, pl. 42, figs. 7, 8 (1890); Foss. Ins. N. A., I, 336, 443, 444, pl. 34, figs. 7, 8 (1890).

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4. NEORTHROBLATTINA ATTENUATA.

Neorthroblattina attenuata Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 110 (1885); Mem. Bost. Soc. Nat. Hist., IV, 467, 468–469, pl. 42, fig. 1 (1890); Foss. Ins. N. A., I, 336, 443, 444–445, pl. 34, fig. 1 (1890).

Triassic of Fair Play, Colo.

18. Genus SCUTINOBLATTINA.

Scutinoblattina Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 110 (1885).

A second genus confined, as yet known, to the Trias and to central Colorado, where three species occur.

Table of the species of Scutinoblattina.

*a*¹. Mediastino-scapular and externomedian veins having a distinctly sinuous course through the middle of the tegmina, both terminating below the apex.
  *b*¹. Anal branches falling on the hind margin .... 1. *S. brongniarti.*
  *b*². Anal branches falling on the anal furrow .... 2. *S. intermedia.*
*a*². Mediastino-scapular and externomedian veins taking a straight course through the middle of the tegmina, both terminating at the tip .... 3. *S. recta.*

1. SCUTINOBLATTINA BRONGNIARTI.

Scutinoblattina brongniarti Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 110–111 (1885) Mem. Bost. Soc. Nat. Hist., IV, 469, pl. 42, fig. 5 (1890); Foss. Ins. N. A., I 370. 445, pl. 34, fig. 5 (1890).

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2. SCUTINOBLATTINA INTERMEDIA.

Scutinoblattina intermedia Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 111 (1885); Mem. Bost. Soc. Nat. Hist., IV., 469, 470, pl. 42, fig. 4 (1890); Foss. Ins. N. A., I, 370, 445, 446, pl. 34, fig. 4 (1890).

Triassic of Fair Play, Colo.

3. SCUTINOBLATTINA RECTA.

Scutinoblattina recta Scudd., Proc. Acad. Nat. Sc. Philad., 1885, 111, (1885); Mem. Bost. Soc. Nat. Hist., IV, 469, 470, pl. 42, fig. 3, 16[1] (1890); Foss. Ins. N. A., I, 370, 445, 446, pl. 34, figs. 3, 16[1] (1890).

Triassic of Fair Play, Colo.

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[1] Erroneously marked 17 on plate. See note on p. 87.

20. Genus ZETOBORA.

Zetobora Burm., Handb. Entom, II, 509–510 (1838).

An extant genus, recognized in the Tertiary rocks of Colorado.

ZETOBORA BRUNNERI.

Zetobora brunneri Scudd., Tert. Ins. N. A., 217, pl. 17, fig. 12 (1890).

Tertiary of Florissant, Colo.

19. Genus HOMŒOGAMIA.

Homœogamia Burm., Handb. Entom., II, 490 (1838).

A tropical American living type of cockroaches; also recognized in the Tertiary of Colorado by a single species.

HOMŒOGAMIA VENTRIOSUS.

Homœogamia ventriosus Scudd., Bull. U. S. Geol. Surv. Terr., I, 447 (1876); Tert. Ins. N. A., 218, pl. 17, fig. 8 (1890).

Tertiary of Florissant, Colo.

21. Genus PARALATINDIA.

Parlatindia Sauss., Rev. Mag. Zool., XXXI, 100–101 (1868).

A distinctively American type of living cockroaches, of which one fossil species occurs in the Tertiaries of Wyoming.

PARALATINDIA SAUSSUREI.

Paralatindia saussurei Scudd., Tert. Ins. N. A., 216, pl. 6. fig. 25 (1890).

Tertiary of Green River, Wyoming.

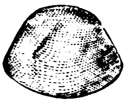
PLATES

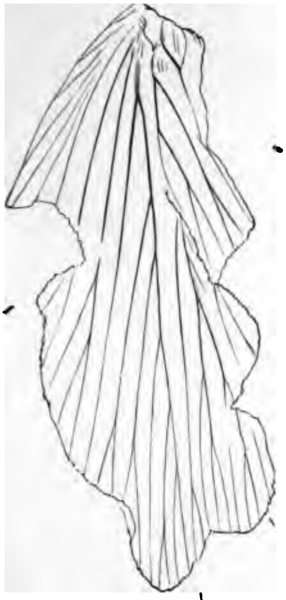
PLATE I.

EXPLANATION OF PLATE I.

Figs. 1 and 4 are from the originals of the Illinois geological survey. Figs. 2, 3, and 5 were drawn by J. Henry Blake; fig. 6 by J. H. Emerton. All the figures are magnified two diameters, excepting figs. 1 and 4, which are of natural size.

Fig. 1. Mylacris anthracophila; pronotum. Colchester, Ill.
2. Mylacris packardii. Bristol, R. I.
3. Mylacris packardii. Bristol, R. I.
4. Mylacris anthracophila; one of the tegmina. Colchester, Ill.
5. Mylacris gurleyi. Mazon Creek, Illinois.
6. Mylacris elongata (2014). Mazon Creek, Illinois.





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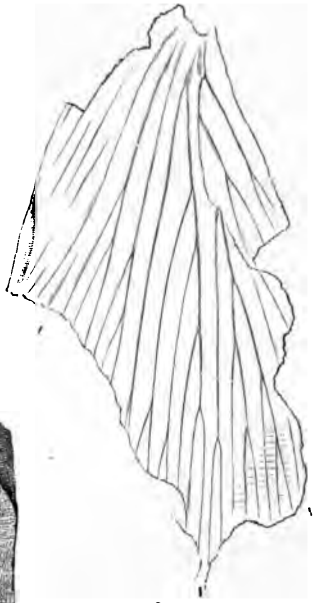

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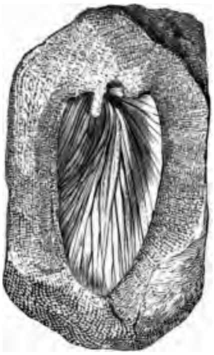

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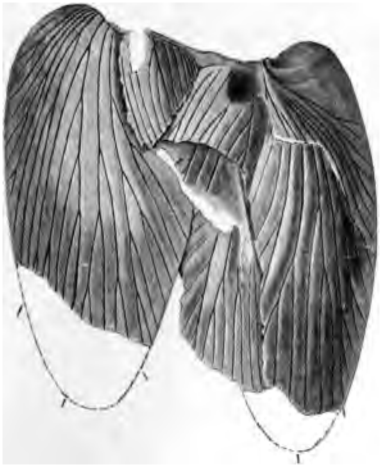

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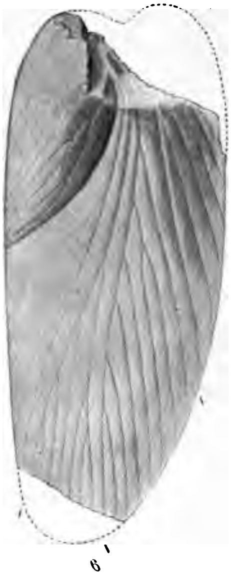

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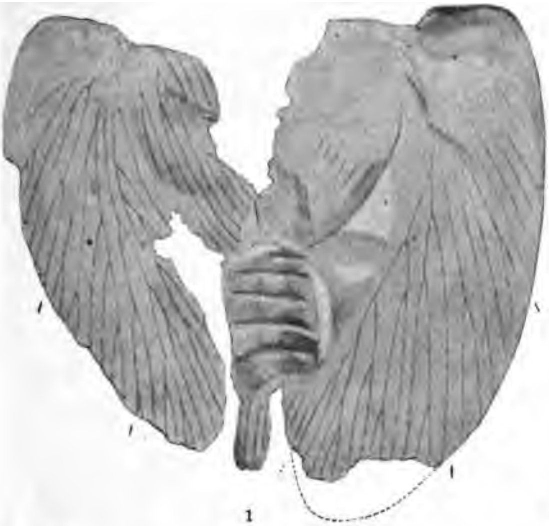
MYLACRIDÆ: SPECIES OF MYLACRIS.

PLATE II.

EXPLANATION OF PLATE II.

Figs. 2 to 4 were drawn by J. Henry Blake; the others by Katherine Peirson Ramsay. All are magnified two diameters.

Fig. 1. Mylacris ampla (2021). Mazon Creek, Illinois.
2. Promylacris testudo (2089). Mazon Creek, Illinois.
3. Promylacris harei (2087). Kansas City, Mo.
4. Mylacridæ sp. Mazon Creek, Illinois.
5. Mylacris antiqua (2036*a*). Mazon Creek, Illinois.
6. Mylacris antiqua (2036*b*). Mazon Creek, Illinois.



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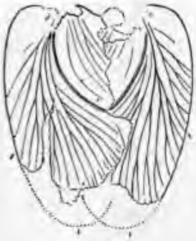

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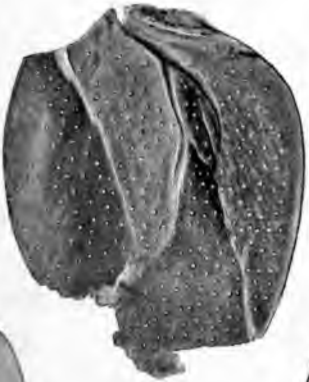

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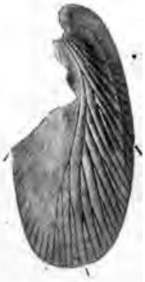

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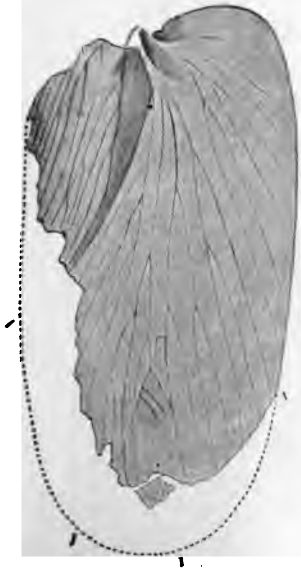

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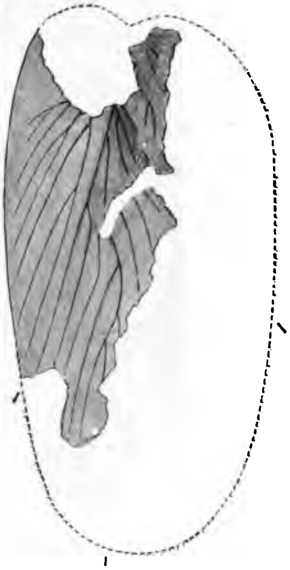

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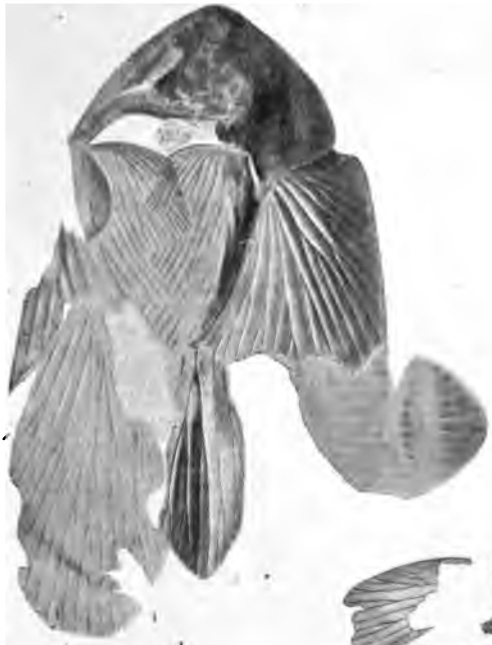
MYLACRIDÆ: SPECIES OF MYLACRIS AND PROMYLACRIS.

PLATE III.

EXPLANATION OF PLATE III.

All the drawings are by J. Henry Blake, and magnified two diameters.

Fig. 1. Promylacris rigida (2086). Mazon Creek, Illinois.
2. Paromylacris ? pluteus (2040). Pittston, Pa.
3. Paromylacris triangularis (2110). Mazon Creek, Illinois.
4. Paromylacris ampla (2088). Mazon Creek, Illinois.
5. Microblattina perdita (2092). East Providence, R. I.
6. Paromylacris clintoniana (2151). Clinton, Mo.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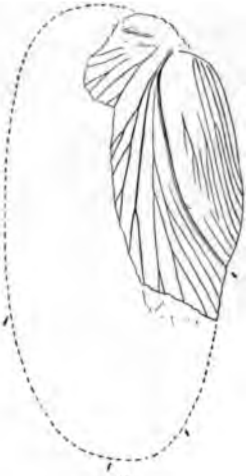
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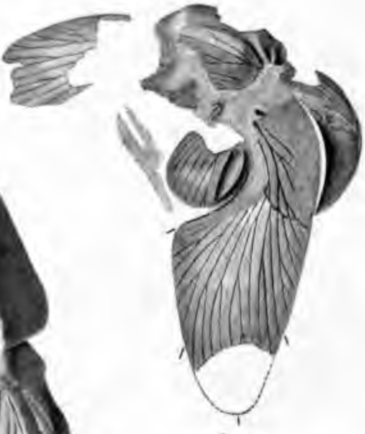
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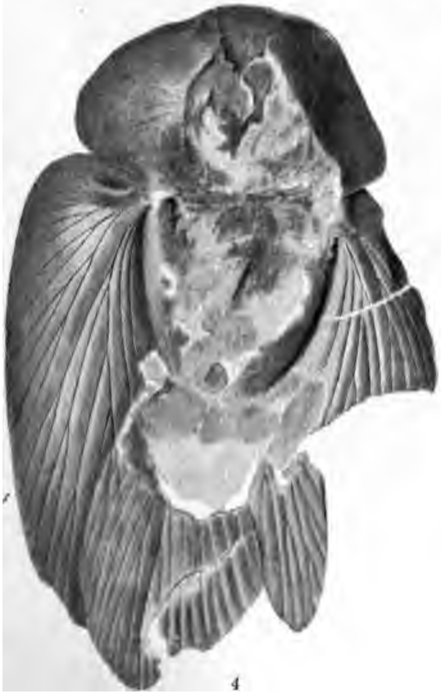
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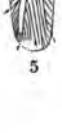
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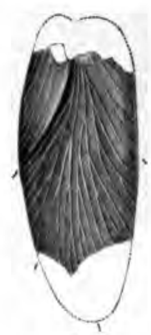
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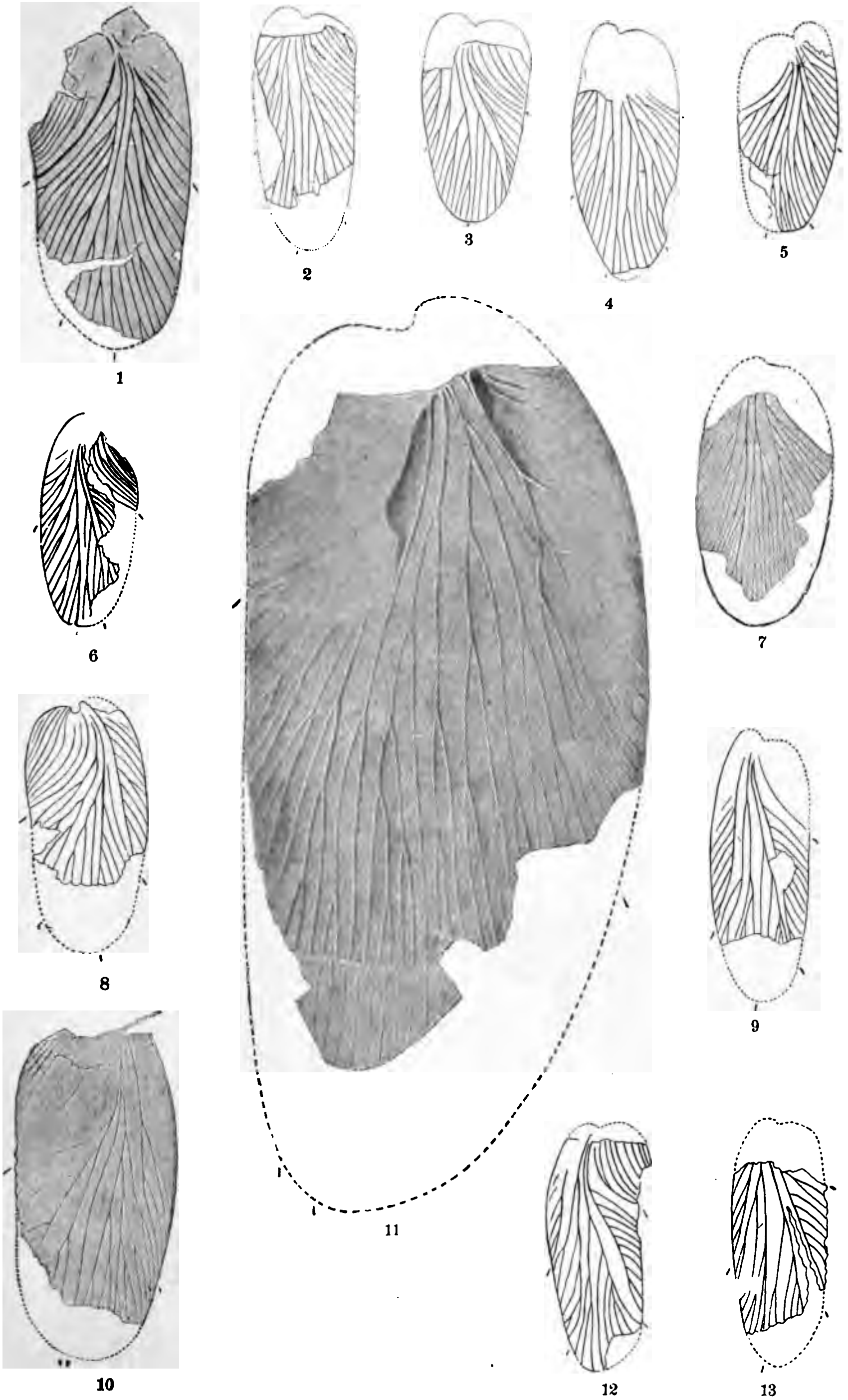
MYLACRIDÆ: SPECIES OF PROMYLACRIS AND PAROMYLACRIS.
BLATTINARIÆ: SPECIES OF MICROBLATTINA.

PLATE IV.

EXPLANATION OF PLATE IV.

All the drawings are by J. Henry Blake, excepting figs. 2 to 4 by S. H. Scudd and fig. 10 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Etoblattina clintoniana (2182). Clinton, Mo.
2. Etoblattina lata (2099). Cassville, W. Va.
3. Etoblattina sagittaria (2100). Cassville, W. Va.
4. Etoblattina mediana (2101). Cassville, W. Va.
5. Etoblattina fossa (182). Richmond, Ohio.
6. Etoblattina ovata (2102). Cassville, W. Va.
7. Etoblattina scholfieldi. East Providence, R. I.
8. Etoblattina debilis (2103). Cassville, W. Va.
9. Etoblattina patiens (2104). Cassville, W. Va.
10. Etoblattina strigosa. Richmond, Ohio.
11. Etoblattina illustris. Pawtucket (?), R. I.
12. Etoblattina detecta (2106*a*). Cassville, W. Va.
13. Etoblattina detecta (2106*c*). Cassville, W. Va.



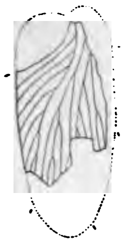
BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE V.

EXPLANATION OF PLATE V.

All the drawings are by J. Henry Blake, excepting figs. 9, 11, 12 by J. H. Emert and figs. 1 and 15 by S. H. Scudder. All are enlarged two diameters.

Fig. 1. Etoblattina residua (2131). Cassville, W. Va.
2. Etoblattina sp. Pawtucket, R. I.
3. Etoblattina mucronata (2105). Cassville, W. Va.
4. Etoblattina exigua (2107). Cassville, W. Va.
5. Etoblattina funeraria (2108). Cassville, W. Va.
6. Etoblattina expuncta (2109). Cassville, W. Va.
7. Etoblattina jeffersoniana (194). Richmond, Ohio.
8. Etoblattina gorhami. Pawtucket, R. I.
9. Etoblattina aperta (2066). Cassville, W. Va.
10. Etoblattina clarkii. Pawtucket, R. I.
11. Etoblattina fasciata. Richmond, Ohio.
12. Etoblattina ramosa (108). Richmond, Ohio.
13. Etoblattina willsiana (176). Richmond, Ohio.
14. Etoblattina benedicta (183). Richmond, Ohio.
15. Etoblattina benedicta (178). Richmond, Ohio.



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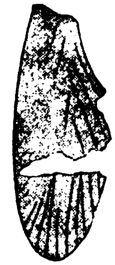

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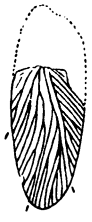

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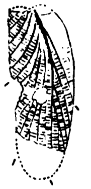

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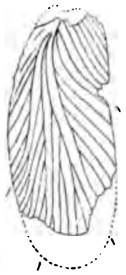

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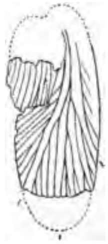

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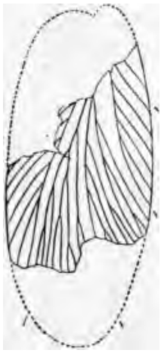

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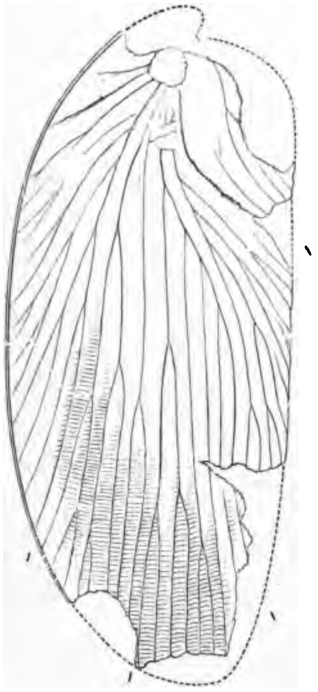

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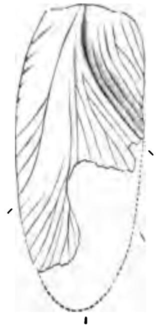

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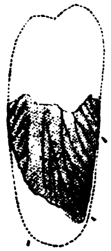

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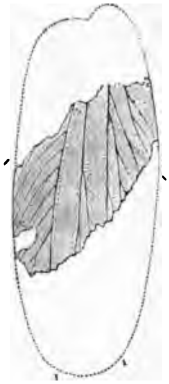

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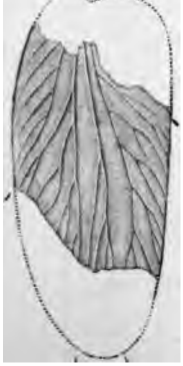

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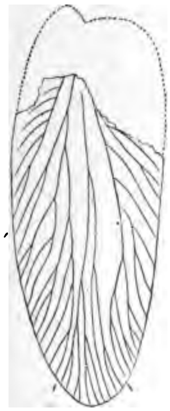

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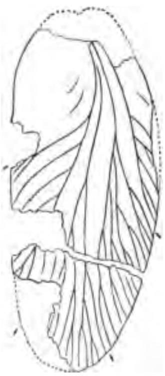

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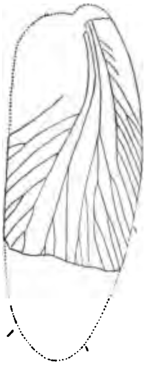

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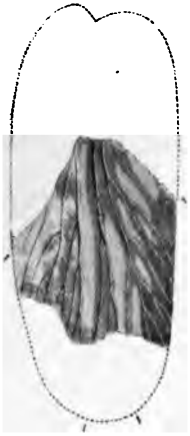
BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE VI.

EXPLANATION OF PLATE VI.

All the drawings are by Katherine Peirson Ramsay, excepting figs. 4 and 6 by J. H. Emerton, and figs. 5 and 8 by J. Henry Blake. All are magnified two diameters.

Fig. 1. Etoblattina maledicta (174). Richmond, Ohio.
2. Etoblattina maledicta (163). Richmond, Ohio.
3. Etoblattina maledicta (164). Richmond, Ohio.
4. Etoblattina funesta (107). Richmond, Ohio.
5. Etoblattina mazona. Mazon Creek, Illinois.
6. Etoblattina tenuis. Richmond, Ohio.
7. Etoblattina exsensa (161). Richmond, Ohio.
8. Etoblattina exsensa (196). Richmond, Ohio.
9. Etoblattina hustoni (122). Richmond, Ohio.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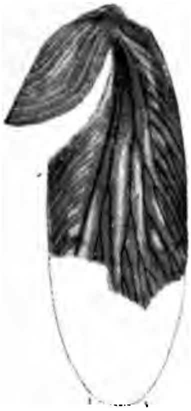
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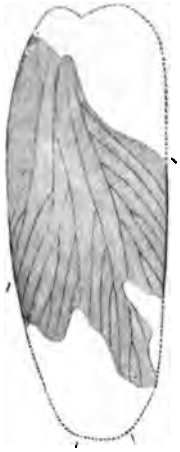
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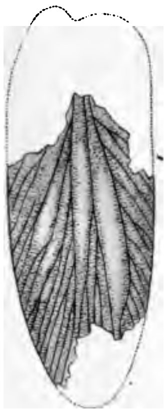
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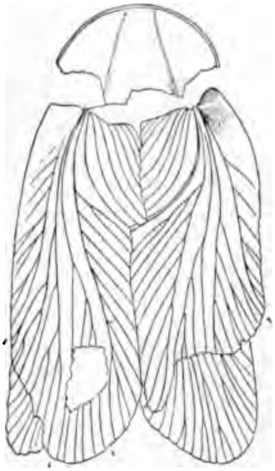
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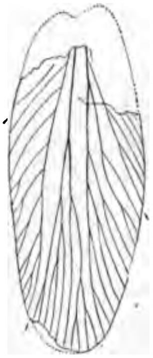
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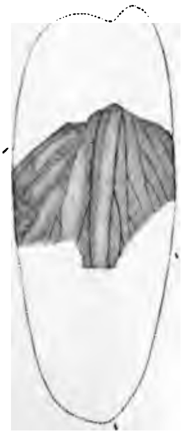
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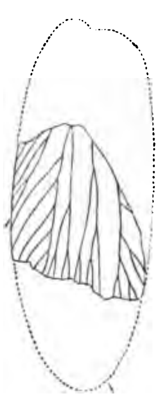
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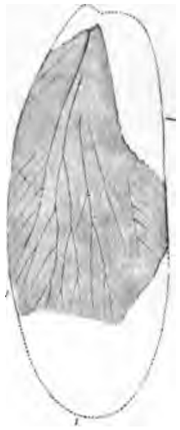
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BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE VII.

EXPLANATION OF PLATE VII.

All the drawings are by J. Henry Blake, excepting figs. 6, 10, 14 to 17 by Kather Peirson Ramsay, and fig. 13 by S. H. Scudder. All are magnified two diameters.

Fig. 1. Etoblattina eakiniana (2111). Cassville, W. Va.
2. Etoblattina accubita (2112). Cassville, W. Va.
3. Etoblattina expulsata (2113*a*). Cassville, W. Va.
4. Etoblattina expulsata (2113*c*). Cassville, W. Va.
5. Etoblattina gratiosa (2114). Cassville, W. Va.
6. Etoblattina macerata (2081). Cassville, W. Va.
7. Etoblattina immolata (2115*c*). Cassville, W. Va.
8. Etoblattina immolata (2115*a*). Cassville, W. Va.
9. Etoblattina mactata (2116). Cassville, W. Va.
10. Etoblattina communis (2117*h*). Cassville, W. Va.
11. Etoblattina communis (2117*c*). Cassville, W. Va.
12. Etoblattina communis (2117*o*). Cassville, W. Va.
13. Etoblattina communis (2117*a*). Cassville, W. Va.
14. Etoblattina communis (2117*e*). Cassville. W. Va.
15. Etoblattina communis (2117*g*). Cassville, W. Va.
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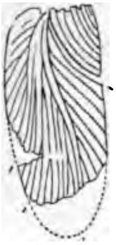
17. Etoblattina communis (2117*i*). Cassville, W. Va.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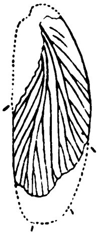
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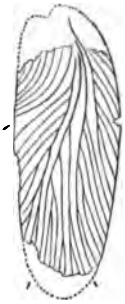
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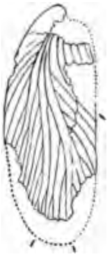
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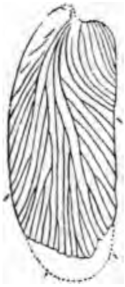
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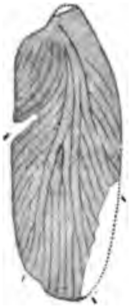
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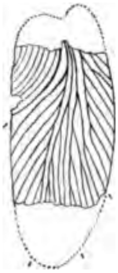
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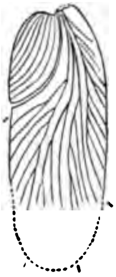
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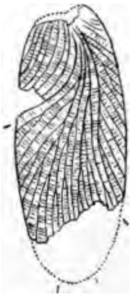
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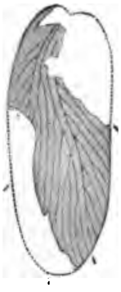
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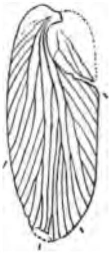
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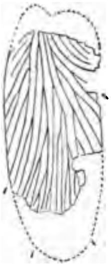
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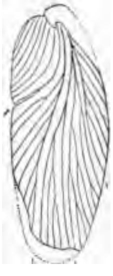
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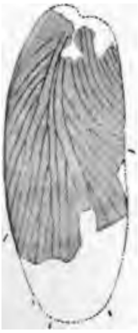
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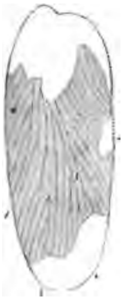
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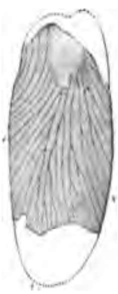
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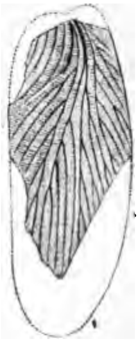
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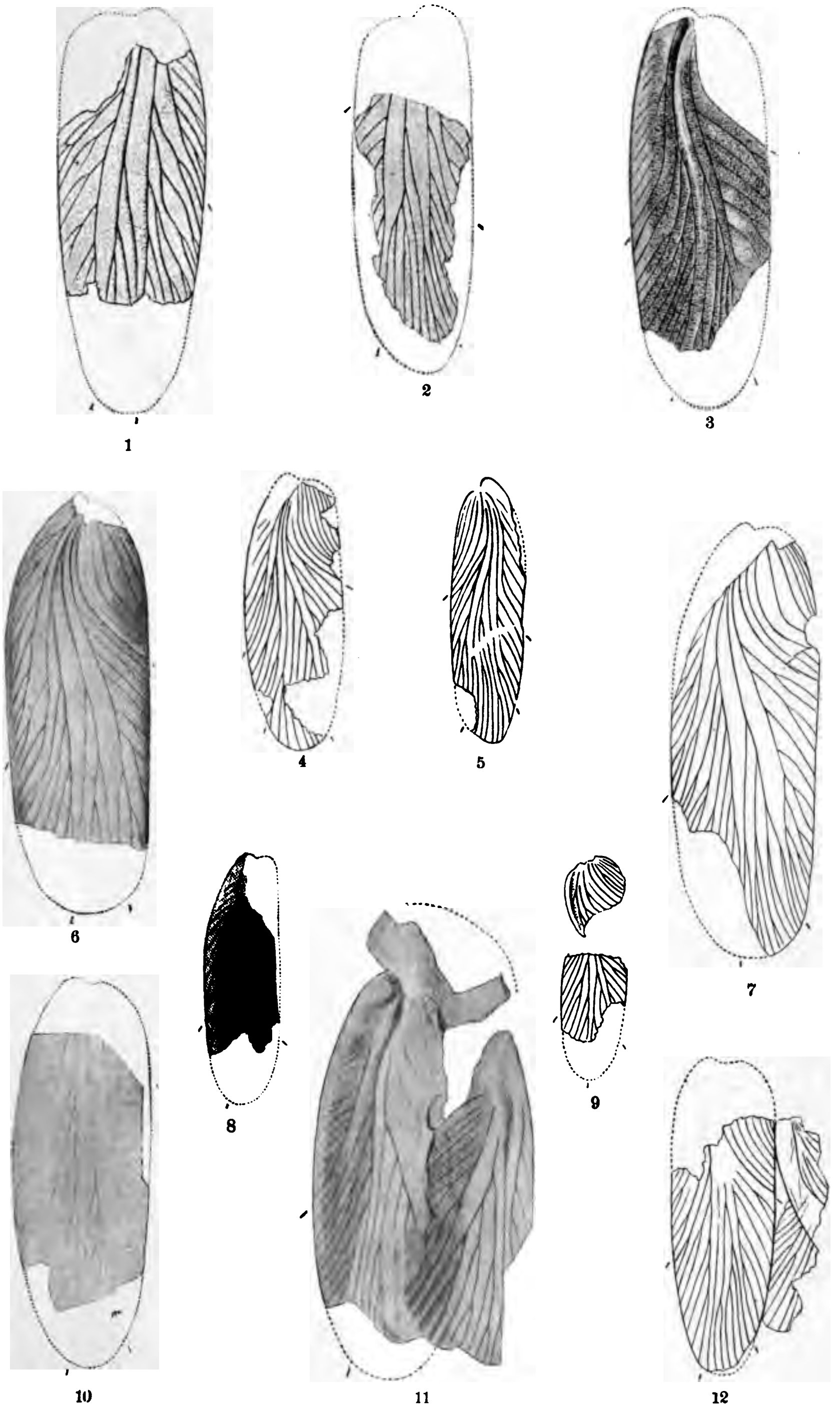
BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE VIII.

EXPLANATION OF PLATE VIII.

Figs. 4, 5, 7, 9, 12 are by J. Henry Blake; figs. 3, 8, 10, 11 by Katherine Peirso Ramsey, and figs. 1, 2, 6 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Etoblattina hastata (106). Richmond, Ohio.
2. Etoblattina marginata (117). Richmond, Ohio.
3. Etoblattina stipata (123). Richmond, Ohio.
4. Etoblattina exsecuta (2120). Cassville, W. Va.
5. Etoblattina arcta (2118). Cassville, W. Va.
6. Etoblattina gracilenta (114). Richmond, Ohio.
7. Etoblattina gracilenta (198). Richmond, Ohio.
8. Etoblattina angusta (2080). Cassville, W. Va.
9. Etoblattina macilenta (2121). Cassville, W. Va.
10. Etoblattina variegata (49). Richmond, Ohio.
11. Etoblattina hilliana (2070). Mazon Creek, Illinois.
12. Etoblattina prædulcis (2119). Cassville, W. Va.



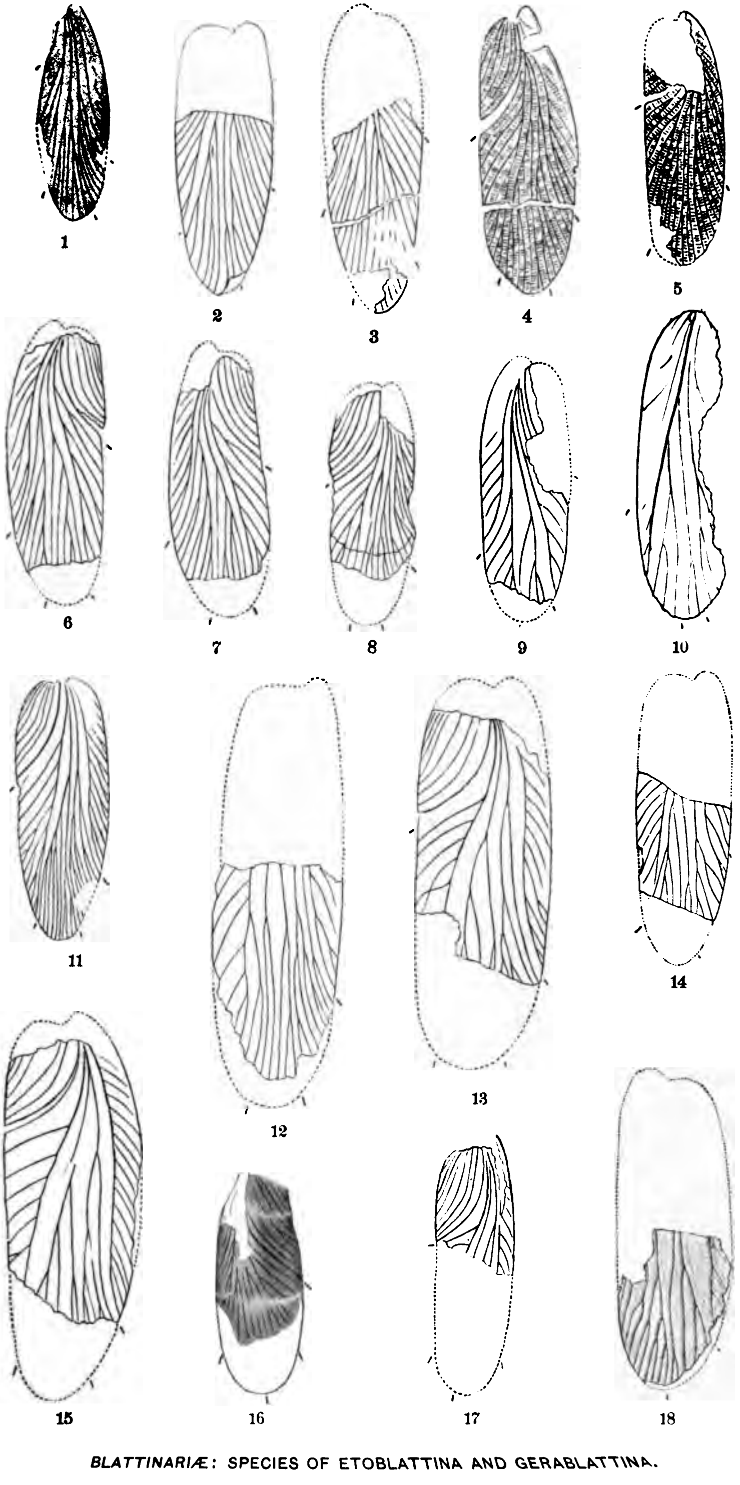
BLATTINARIÆ: SPECIES OF ETOBLATTINA.

PLATE IX.

EXPLANATION OF PLATE IX.

All the drawings are by J. Henry Blake, excepting figs. 2 and 14 by S. H. Scudder, and fig. 18 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Etoblattina exilis. East Providence, R. I.
2. Etoblattina rogi (2122*b*). Cassville, W. Va.
3. Etoblattina rogi (2122*a*). Cassville, W. Va.
4. Etoblattina expugnata (2085). Cassville, W. Va.
5. Etoblattina obatra (2123). Cassville, W. Va.
6. Etoblattina secreta (2125*a*). Cassville, W. Va.
7. Etoblattina secreta (2125*c*). Cassville, W. Va.
8. Etoblattina imperfecta (2124). Cassville, W. Va.
9. Etoblattina invisa (2126). Cassville, W. Va.
10. Etoblattina reliqua. Pawtucket, R. I.
11. Etoblattina latebricola (2091). East Providence, R. I.
12. Etoblattina defossa (2128). Cassville, W. Va.
13. Etoblattina occulta (2127). Cassville, W. Va.
14. Etoblattina recidiva (2129). Cassville, W. Va.
15. Gerablattina diversinervis (2141). Cassville, W. Va.
16. Gerablattina inculta (2139). Cassville, W. Va.
17. Gerablattina perita (2140). Cassville, W. Va.
18. Gerablattina apicalis (112). Richmond, Ohio.



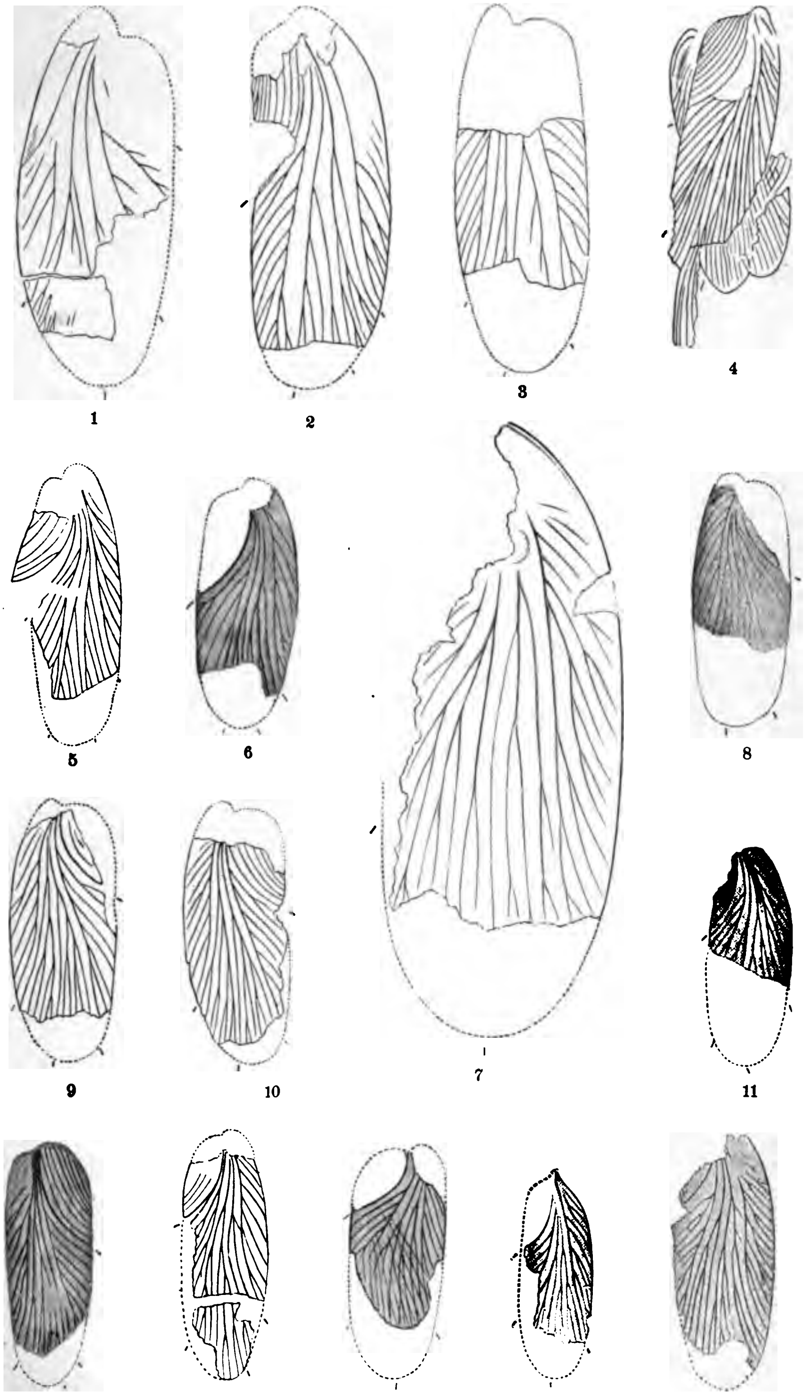
BLATTINARIÆ: SPECIES OF ETOBLATTINA AND GERABLATTINA.

PLATE X.

EXPLANATION OF PLATE X.

All the drawings are by J. Henry Blake, excepting figs. 3 and 5 by S. H. Scudde and fig. 8 by Katherine Peirson Ramsay. All are magnified two diameters.

Fig. 1. Gerablattina richmondiana (169). Richmond, Ohio.
2. Gerablattina cassvici (2142*a*). Cassville, W. Va.
3. Gerablattina cassvici (2142*c*). Cassville, W. Va.
4. Gerablattina concinna (2077*a*). Cassville, W. Va.
5. Gerablattina concinna (2077*c*). Cassville, W. Va.
6. Gerablattina abdicata (2143). Cassville, W. Va.
7. Gerablattina scapularis. Pawtucket, R. I.
8. Gerablattina uniformis (2082*f*). Cassville, W. Va.
9. Gerablattina uniformis (2082*a*). Cassville, W. Va.
0. Gerablattina uniformis (2082*c*). Cassville, W. Va.
11. Gerablattina uniformis (2082*e*). Cassville, W. Va.
12. Gerablattina permanenta (2144). Cassville, W. Va.
13. Gerablattina permacra (2188). Cassville, W. Va.
14. Gerablattina eversa (2145). Cassville, W. Va.
15. Gerablattina deducta (2146). Cassville, W. Va.
16. Gerablattina fraterna. East Providence, R. I.



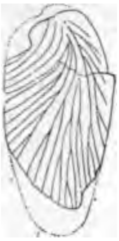
BLATTINARIÆ: SPECIES OF GERABLATTINA.

PLATE XI.

EXPLANATION OF PLATE XI.

All the drawings are by J. Henry Blake, excepting figs. 1 and 13 by S. H. Scudder, figs. 11 and 15 by Katherine Peirson Ramsay, and fig. 12 by J. H. Emerton. All are magnified two diameters.

Fig. 1. Gerablattina radiata (2147). Cassville, W. Va.
2. Gerablattina lata (2148). Cassville, W. Va.
3. Gerablattina rotundata (2149). Cassville, W. Va.
4. Gerablattina ovata (2150). Cassville, W. Va.
5. Gerablattina minima (2183). Richmond, Ohio.
6. Oryctoblattina laqueata (2136). Kansas City, Mo.
7. Anthracoblattina americana (2137). Clinton, Mo.
8. Anthracoblattina virginiensis (2138). Cassville, W. Va.
9. Progonoblattina columbiana. Mazon Creek, Illinois.
10. Petrablattina hastata (2133). Cassville, W. Va.
11. Poroblattina ohioensis (162). Richmond, Ohio.
12. Poroblattina longinqua (111). Richmond, Ohio.
13. Poroblattina gratiosa (2134). Cassville, W. Va.
14. Poroblattina complexinervis (2135). Cassville, W. Va.
15. Poroblattina fossa (2083). Cassville, W. Va.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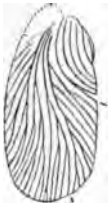
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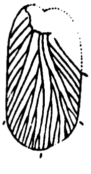
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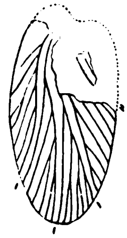
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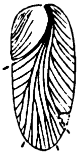
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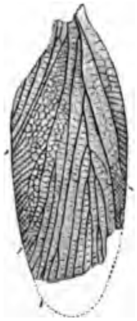
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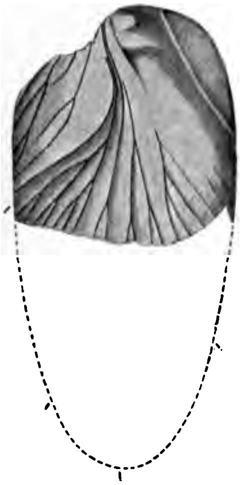
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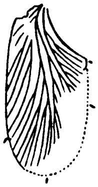
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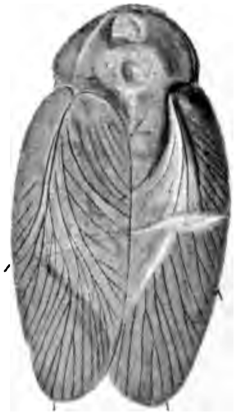
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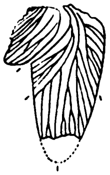
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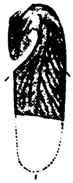
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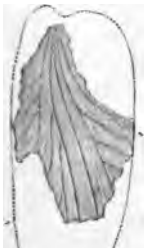
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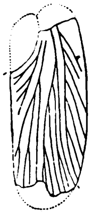
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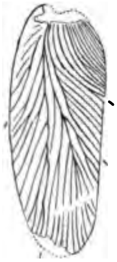
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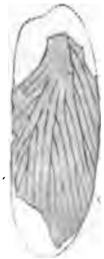
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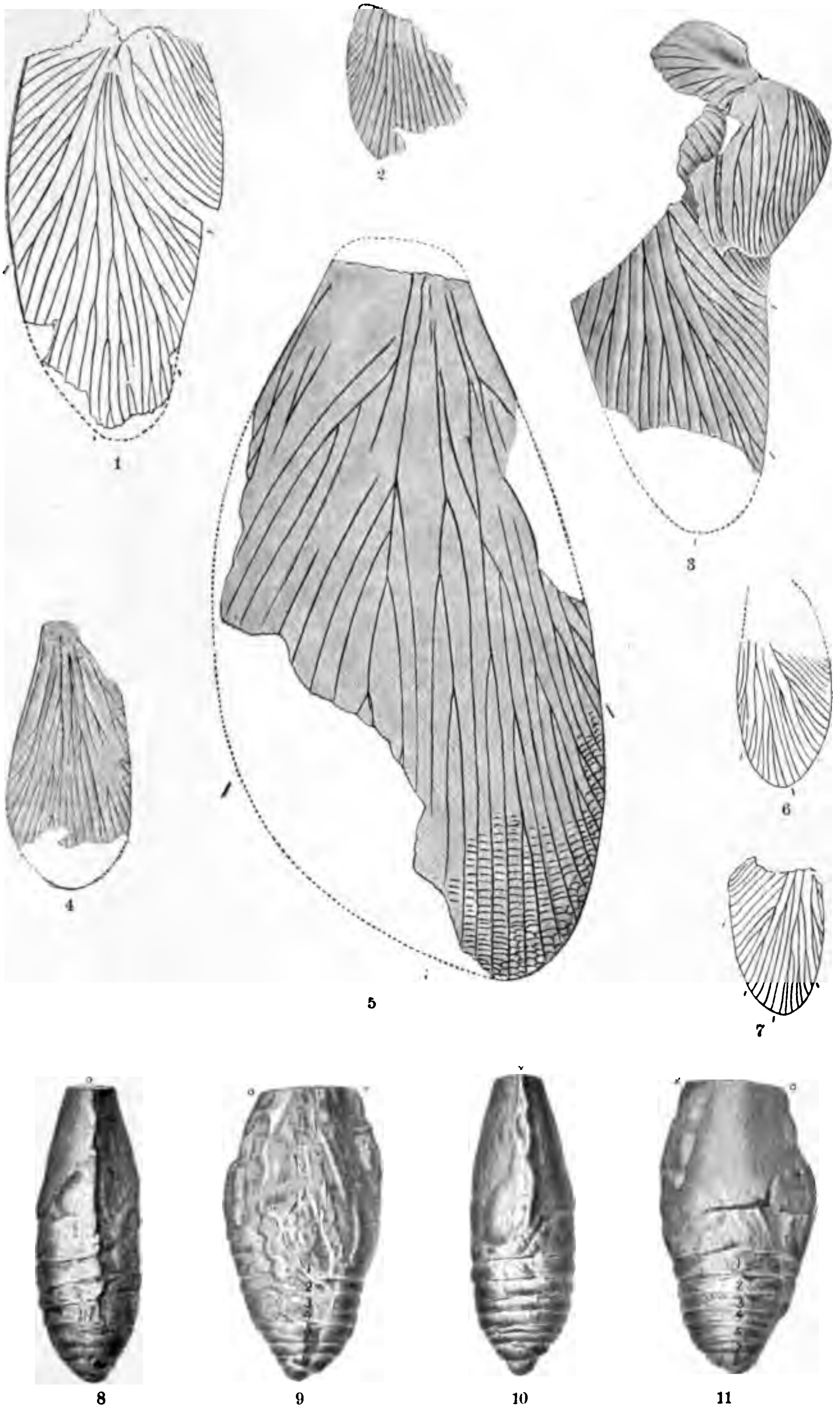
ATTINARIÆ: SPECIES OF GERABLATTINA, ORYCTOBLATTINA, ANTHRACOBLATTINA, PROGONOBLATTINA, PETRABLATTINA, AND POROBLATTINA.

PLATE XII.

EXPLANATION OF PLATE XII.

All the drawings are by J. Henry Blake, excepting fig. 5 which is by Katherine Peirson Ramsay. All are magnified two diameters, excepting figs. 8–11 which are of natural size.

Fig. 1. Etoblattina deanensis (2132*b*). Forest of Dean, England.
2. Etoblattina sp. East Providence, R. I.
3. Etoblattina deanensis (2132*c*). Forest of Dean, England.
4. Etoblattina sp.; hind wing. Cranston, R. I.
5. Blattina sp.; hind wing (2038). Mazon Creek, Illinois.
6. Etoblattina sp.; hind wing (2084*a*). Cassville, W. Va.
7. Etoblattina sp.; hind wing (2084*b*). Cassville, W. Va.
8. Body of cockroach; right-side view (4941). Illinois. (See p. 25.)
9. The same; ventral surface.
10. The same; left-side view.
11. The same; dorsal surface.



MISCELLANEOUS REMAINS OF COCKROACHES.

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THE CONSTITUTION OF THE SILICATES

BY

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CHIEF CHEMIST

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THE CONSTITUTION OF THE SILICATES.

By F. W. Clarke.

CHAPTER I.

INTRODUCTION.

In the solid crust of the earth the silicates are by far the most important constituents. They form at least nine-tenths of the entire known mass, and comprise practically all of the rocks except the sandstones, quartzites, and carbonates; even these exceptions are commonly derivatives of the silicates, which break up under various conditions, yielding simpler bodies of their own class, together with free silica and limestone. From a geological point of view, therefore, the silicates are of fundamental importance, and a study of their inner constitution may be reasonably expected to shed light upon many serious problems. For example, every primitive rock or eruptive mass contains an aggregation of silicates, each one of which is capable of undergoing chemical change in accordance with limitations imposed by the structure of its molecules. When these changes take place, secondary compounds, alteration products, are formed, and in time the rock becomes transformed into new substances, quite unlike those which originally existed. A knowledge of the processes which thus occur should be applicable to the study of the rocks, and should ultimately render it possible so to investigate a metamorphosed mass as to clearly indicate its origin. These processes are dependent upon chemical structure, and the study of this with regard to the silicates is the purpose of the present memoir.

From the standpoint of the chemist the problem under consideration is one of great importance, but also of great difficulty. Some of the difficulty is real, some only apparent. At first sight the natural silicates appear to be compounds of great complexity; but this difficulty becomes much less serious after careful examination. Few of the natural silicates exist in even an approximately pure condition; many that seem fresh have undergone traces of alteration; isomorphous mixtures are exceedingly common; and much confusion is due to defective analyses. By multiplied observations these difficulties can be eliminated from the problem, but others yet remain to be disposed of. The organic chemist, to whom most of our knowledge of chemical structure is due, deals mainly with bodies of known molecular weight, which can be measured by the density of a vapor or by cryoscopic methods. To the mineral chemist such knowledge is not available, for the compounds which interest him are neither volatile nor soluble, and their molecular weights can only be inferred. The simplest empirical formula of a silicate is not necessarily its true formula; the latter may be a multiple or polymer of the former; and here we find a difficulty which is at present almost insuperable. Strong evidence can be brought to bear upon this side of the question, but it is only partial evidence and not finally conclusive. The case, however, is by no means hopeless, for even the partial solution of a problem is better than no solution at all. An approximation is some gain, and it is possible so to investigate the constitution of the silicates as to bring many relations to light, developing formulæ which express those relations and indicate profitable lines for future research.

The problem is open to attack from several points of view, and various methods of investigation can be brought to bear upon it. First, of course, the empirical formula of each silicate must be definitely ascertained, which involves the discussion of sufficiently numerous analyses and the elimination of possible errors due to impurity, alteration, and isomorphous admixtures. In this work the microscope renders important service to the analyst, and makes his results much more certain. By the aid of the microscope many supposed mineral species have been proved to be mixtures, and the problem of the silicates has been thereby simplified. Indeed, the final outcome of such investigation generally indicates, for any given natural silicate, simplicity of composition; and this is what should be expected. These compounds are, as a rule, exceedingly stable salts, while complex substances are commonly characterized by instability. The mineral silicates are formed in nature under conditions of high temperature or are deposited from solutions in which many reactions are simultaneously possible, and these circumstances are strongly opposed to any great complications of structure. Furthermore, they are quite limited in number, only a few hundred at most being known; whereas, if complexity were the rule among them, slight variations in origin should produce corresponding variations in character, and millions of different minerals would be generated. That few variations exist is presumptive evidence that only few are possible, and hence simplicity of constitution is reasonably to be inferred. In fact, we find the same small range of mineral species occurring under the same associations in thousands of widely separated localities; a few typical forms containing a few of the commonest metals being almost universally distributed. The longer the evidence is considered, the stronger the argument in favor of simple silicate structures becomes.

Having established the empirical formula of a silicate, its physical properties may next be considered; and of these the crystalline form and the specific gravity are the most important. From identity of form, or complete isomorphism between two species, we infer similarity of chemical structure, and the inferences thus drawn are often of the highest value. On the other hand, dissimilarity of form and identity of composition indicate isomerism, as for example in the cases of andalusite and kyanite; and here again we secure evidence which bears directly upon the study of chemical constitution. From the specific gravity the so-called molecular volume of a species may be computed, and that datum gives suggestions as to the relative condensation of a molecule in comparison with others of similar empirical composition. For instance, leucite and jadeite are empirically of similar type; but the latter has by far the greater density, together with superior hardness. It is, therefore, presumably more complex than leucite, and this supposition must be taken into account in considering its ultimate formula.

From what may be called the natural history of a mineral, still another group of data can be drawn, relating to its genesis, its constant associations, and its alterability. In this connection pseudomorphs become of the utmost interest, and, properly studied, shed much light upon otherwise obscure problems. An alteration product is the record of a chemical change, and as such has weighty significance. The decomposition of spodumene into eucryptite and albite, the transformation of topaz into mica, and many like occurrences in nature, are full of meaning with reference to the problem now under consideration. Just here, however, great caution is necessary. Mineralogical literature is full of faulty records regarding alterations, and many diagnoses need to be revised. Pseudomorphs have been named by guesses, based upon their external appearance, and often a compact mica has been called steatite or serpentine. In every case an alteration product should be identified with extreme care, both by chemical and by microscopical methods; for without such precautions there is serious danger of error. In each instance the supposed fact must be scrupulously verified.

Closely allied to the study of natural alterations is their artificial production in the laboratory. The transformation of leucite into analcite, and of analcite back into leucite, is a case in point, and the admirable researches of Lemberg furnish many other examples. Work of this character is much less difficult than was formerly supposed, and its analogy to the methods of organic chemistry renders its results highly significant. Atoms, or groups of atoms, may be split off from a molecule and replaced by others, and the information so gained bears directly upon the question of chemical structure. With evidence of this sort relations appear which could not otherwise be recognized, and these relations may be closely correlated with observations of natural occurrences.

Evidence of the same or similar character is also furnished by the thermal decomposition of silicates, a line of investigation which has been successfully followed by several investigators. Thus garnet, when fused, yields anorthite and an olivine; natrolite gives nepheline; talc, upon ignition, liberates silica; and the prolonged heating of ripidolite produces an insoluble residue having the empirical composition of spinel. All of these facts have relevancy to the problem of chemical constitution, and their number could easily be enlarged by experiment. As yet the field has been barely scratched upon the surface; upon deeper cultivation a goodly crop may be secured.

The artificial synthesis of mineral species, with the allied study of crystalline slags and furnace products, furnishes still more evidence of pertinent utility. But, here again, caution is needed in the interpretation of results. A compound may be produced in various ways, and it does not follow that the first method which is successful in the laboratory is the method pursued by nature in the depths of the earth. The data yielded by synthesis are undoubtedly helpful in the determination of chemical constitution, but they furnish only a small part of the proof needed for complete demonstration, and their applicability to geological questions is limited in the extreme. For the latter purpose they are only suggestive, not final.

Suppose now that the empirical formula of a silicate has been accurately fixed, and that a mass of data such as I have indicated are available for combination with it. Suppose the physical properties to be determined, the natural relations known, the alteration products observed, its chemical reactions and the results of fusion ascertained; what then? It still remains to combine these varied data into one expression which shall symbolize them all, and that expression will be a constitutional formula. To develop this, the established principles of chemistry must be intelligently applied, with due regard to recognized analogies. The grouping of the atoms must be in accord with other chemical knowledge; they must represent known or probable silicic acids; and any scheme which fails to take the latter consideration into account is inadmissible. Not merely composition, but function also is to be represented, and the atomic linking which leaves that disregarded may be beautiful to see, but is scientifically worthless. A good formula indicates the convergence of knowledge; if it fulfills that purpose it is useful, even though it may be supplanted at some later day by an expression of still greater generality. Every formula should be a means toward this end, and the question whether it is assuredly final is of minor import. Indeed, there is no formula in chemistry to-day of which we can be sure that the last word has been spoken.

In the development of constitutional formulæ for the silicates it sometimes happens that alternatives offer between which it is difficult to decide. Two or more distinct expressions may be possible, with the evidence for each so strong that neither can be accepted or abandoned. In such cases nothing can be done but to state the facts and await the discovery of new data, to which, however, the formulæ themselves may give clews. This sort of uncertainty is peculiarly common among the hydrous silicates, and often arises from the difficulty of discriminating between water of crystallization, so called, and constitutional hydroxyl. If in every silicate analysis the state of hydration were carefully examined, the conditions of dehydration being observed at different temperatures, much of this obscurity would be avoided.

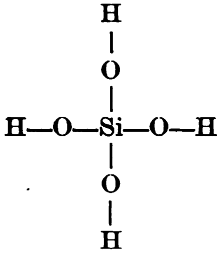
In discriminating between rival formulæ, one rule is provisionally admissible. Other things being equal, a symmetrical formula is more probable than one which is unsymmetrical. Symmetry in a molecule conduces to stability; most of the silicates are exceedingly stable; and hence symmetry is to be expected. This rule has presumptive value only, as an aid to judgment, and can not be held rigidly. It expresses a probability, but gives no proof. In a problem like that of the silicates, however, even a suggestion of this kind may render legitimate assistance.

CHAPTER II.

THE THEORY OF THE SILICATES.

If all of the silicates were salts of a single silicic acid, the problem of their constitution would be relatively simple; but this is not the case. Many silicic acids are theoretically possible, and several of them have representatives in the mineral kingdom, although the acids themselves, as such, are not known. Their nature must be inferred from their salts, and especially from their ethers, and this side of the problem is the first to be considered.

Since silicon is quadrivalent, its ortho acid is necessarily represented by one atom of the element united with four hydroxyl groups, thus—$\mathrm{Si(OH)_4}$, or, structurally:



$$\begin{array}{c} \mathrm{H} \\ | \\ \mathrm{O} \\ | \\ \mathrm{H—O—Si—O—H} \\ | \\ \mathrm{O} \\ | \\ \mathrm{H} \end{array}$$

To this acid, orthosilicic acid, the normal silicic ethers and many common minerals correspond. Its normal salts, reduced to their simplest expressions, may be typically represented as follows:

Types.	*Examples.*
$\mathrm{R^{i}_4SiO_4}$	$\mathrm{(C_2H_5)_4SiO_4}$
$\mathrm{R^{ii}_2SiO_4}$	$\mathrm{Mg_2SiO_4}$
$\mathrm{R^{iii}_4(SiO_4)_3}$	$\mathrm{Al_4(SiO_4)_3}$
$\mathrm{R^{iv}SiO_4}$	$\mathrm{ZrSiO_4}$

Any silicate in which the oxygen atoms outnumber the silicon atoms by more than four to one, as for example the compound $\mathrm{Al_2SiO_5}$, must be regarded as a basic salt.

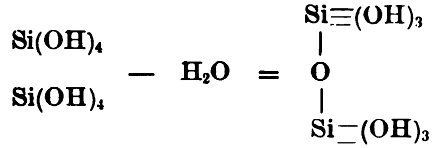
By elimination of water orthosilicic acid may be conceived as yielding, first, metasilicic acid, $\mathrm{H_2SiO_3}$, and, secondly, the anhydride, $\mathrm{SiO_2}$, thus:

$$\mathrm{Si(OH)_4} \qquad \mathrm{O{=}Si{=}(OH)_2} \qquad \mathrm{O{=}Si{=}O}$$

Corresponding to metasilicic acid many salts are known, but as yet no ethers have been certainly obtained. The ethers first described by Ebelmen were supposed to be metasilicates, but all recent investigations have shown them to be ortho compounds, possibly more or less impure. Troost and Hautefeuille, however, have described an ether having the formula, $(C_2H_5)_8Si_4O_{12}$, which is a polymer of a metasilicate; but its true nature has not been determined. The simplest formulæ for typical metasilicates are as follows:

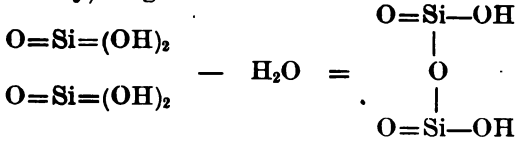
Types.	*Examples.*
$R^{i}_2SiO_3$	Na_2SiO_3
$R^{ii}SiO_3$	$MgSiO_3$
$R^{iii}_2(SiO_3)_3$	$Al_2(SiO_3)_3$*
$R^{iv}(SiO_3)_2$	$Zr(SiO_3)_2$*

By eliminating a molecule of water from two molecules of orthosilicic or metasilicic acid, a disilicic acid may be produced. From orthosilicic acid we have



$$\begin{array}{l}\mathrm{Si(OH)_4}\\ \\ \mathrm{Si(OH)_4}\end{array} - \mathrm{H_2O} = \begin{array}{c}\mathrm{Si{\equiv}(OH)_3}\\ |\\ \mathrm{O}\\ |\\ \mathrm{Si{\equiv}(OH)_3}\end{array}$$

or, $H_6\,Si_2\,O_7$; a sexbasic acid of which several ethers have been obtained. It is, therefore, a well-established acid, and a number of silicates appear to be salts of it. It may be called diorthosilicic acid. From metasilicic acid, in the same way, we get



$$\begin{array}{l}\mathrm{O{=}Si{=}(OH)_2}\\ \\ \mathrm{O{=}Si{=}(OH)_2}\end{array} - \mathrm{H_2O} = \begin{array}{c}\mathrm{O{=}Si{-}OH}\\ |\\ \mathrm{O}\\ |\\ \mathrm{O{=}Si{-}OH}\end{array}$$

or dimetasilicic acid, $H_2Si_2O_5$. No ethers of this acid are known, but among its salts are the minerals petalite, milarite, ptilolite, and mordenite.

By a similar process, that is, the elimination of water from three or four molecules of orthosilicic acid, a series of tri- and tetrasilicic acids may be theoretically developed. These higher acids would present many possibilities for isomerism, and with their long chains of atoms would presumably be unstable. At all events, with a single exception, it is unnecessary to consider them in order to account for the natural silicates. The one exception is the tetrabasic acid $H_4Si_3O_8$, which appears most notably in eudidymite, the feldspars, the micas, and the scapolite group. The feldspars of this type, however, albite and orthoclase, are represented by Groth as mixed salts of two other silicic acids, when $Si_2O_5+SiO_3=Si_3O_8$; so that the trisilicic acid in question can be left out of consideration. But a general view of the whole field seems to point to its existence; at least greater simplicity is secured by retaining it in the scheme of silicic acids; and that policy will be followed throughout this memoir. As opposed to Groth's view, we have also to consider the theory of Becker* that metasilicates may be really mixtures or compounds of ortho- and trisilicates, with $H_4SiO_4 + H_4Si_3O_8 = 4H_2SiO_3$. This theory may easily be pushed to an extreme, for the weight of evidence shows that true metasilicates exist; but in many cases it has real significance; that is, mixed salts are known having pseudometasilicate ratios, and these are most simply explained by Becker's theory, which, in the case of the micas, had been independently developed by myself. As to the constitution of trisilicic acid, we have no positive evidence, and at least two independent structures are conceivable, thus:

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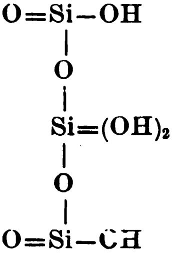
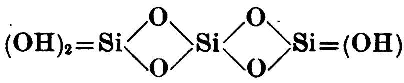
* Salts not actually known, but theoretically possible.



$$\begin{array}{c} O{=}Si{-}OH \\ | \\ O \\ | \\ Si{=}(OH)_2 \\ | \\ O \\ | \\ O{=}Si{-}OH \end{array}$$

and



The first of these formulæ has the closer analogy with the formulæ of the other silicic acids, and is, therefore, in default of evidence, to be preferred. Furthermore, it indicates possibilities of isomerism, such as we find in the case of orthoclase and microcline, a consideration which is well worth bearing in mind.

So far, then, there are five silicic acids whose salts occur in the crust of the earth. They are:

Orthosilicic acid	H_4SiO_4
Metasilicic acid	H_2SiO_3
Diorthosilicic acid	H_6Si_2O
Dimetasilicic acid	H_2Si_2O
Trisilicic acid	H_4Si_3

and unless we admit the possible polymerization of metasilicic acid as suggested by Troost and Hautefeuille's ether, no others need b invoked in order to account for the facts which are now available The possibility of other silicic acids is an entirely distinct question.

If the natural silicates were simple normal salts of the five silicic acids the problem of their constitution would not be difficult. But relatively few of the known species are of this description; the greater number are double salts, and even triple replacements are not uncommon. Furthermore, there are acid and basic salts to be interpreted, and the latter class offers the most serious *difficulties. A basic metasilicate, for example, may have the same empirical composition as an* orthosilicate; so that its ratios, studied apart from other evidence, tell nothing as to the class in which it belongs. Take for instance the formula Al_2SiO_5, which represents the composition of three distinct minerals, andalusite, sillimanite, and kyanite, and it admits of several different structural expressions. As a basic metasilicate it may be written

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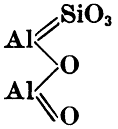
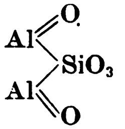
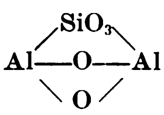
*Am. Jour. Sci., (3) XXXVIII, p. 154, 1889.

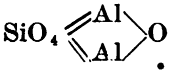






and as an orthosilicate it becomes either

$O=Al-SiO_4\equiv Al$, or



If its molecular weight is a multiple of that indicated by the formula Al_2SiO_5, then the possibilities of isomeric structure become still more complicated. Its composition alone does not give its molecular structure, and other evidence, as shown in the introduction to this memoir, must be brought to bear before the problem can be even approximately solved. This evidence is sometimes available, sometimes not, as will be seen in the systematic discussion of the individual species later.

A hasty glance over the entire field of the natural silicates will show, first, that many of them are most easily interpreted as orthosilicates, and, secondly, that by far the greater number are salts of aluminum. As regards both abundance and variety the aluminous silicates outrank all the others, and from the wide range of composition which they exhibit we can obtain clews to their constitution. In other words, they furnish the most evidence, and some of it is of the highest import. Their relations to one another are oftentimes clear and unmistakable, so that the constitution of one salt is the key to that of a second; and thus generalization becomes possible.

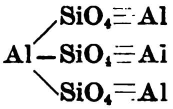
If we consider first the orthosilicates of aluminum, one general relation is easily made apparent. By a general relation I do not mean a universal relation, for exceptions are possible; but only that many of the salts are connected by a simple regularity, or even a law. To make this apparent it is necessary to recognize the fact that aluminum is now properly regarded as a trivalent metal, its formerly supposed quadrivalency being no longer admissible. Formulæ in which aluminum appears as a tetrad are not valid; and ferric iron, which replaces aluminum, follows the same rule. This point has been made clear by the vapor density and cryoscopic investigations of recent years, and is sustained also by the position of aluminum in the periodic classification of the elements.

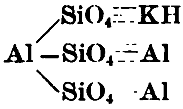
This much admitted, the general relation of which I have spoken is as follows: Many, perhaps all, of the orthosilicates of aluminum are most simply represented as substitution derivatives of the normal salt $Al_4(SiO_4)_3$. To illustrate this rule for present purposes, the following examples will suffice:

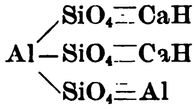
Aluminum orthosilicate	$Al_4(SiO_4)_3$
Eucryptite	$Al_3(SiO_4)_3Li_3$
Nephelite	$Al_3(SiO_4)_3Na_3$
Kaliophilite	$Al_3(SiO_4)_3K_3$
Muscovite	$Al_3(SiO_4)_3KH_2$
Paragonite	$Al_3(SiO_4)_3NaH_2$
Andalusite	$Al_3(SiO_4)_3(AlO)_3$
Topaz	$Al_3(SiO_4)_3(AlF_2)_3$
Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Biotite	$Al_2(SiO_4)_3MgKH$
Grossularite	$Al_2(SiO_4)_3Ca_3$
Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Phlogopite	$Al(SiO_4)_3Mg_3KH_2$

These formulæ express not only the composition of the minerals, but also many facts concerning their relations, such as their association, their alteration one into another, and so on. Thus, topaz and andalusite are crystallographically akin; both minerals, as well as others in the series, alter easily into muscovite, and these facts become intelligible in the light of the formulæ given. In the use of the formulæ, however, one possible misconception must be avoided. They express a relationship of constitution, but do not imply that Nature first generated the normal salt and then actually developed the other compounds from it. To emphasize this point an analogy may be drawn from organic chemistry. Alizarin, derived constitutionally from anthracene, was originally obtained from a glucoside contained in madder root. But nobody supposes that the madder plant took anthracene as a starting point from which to produce the dye. The constitutional or structural derivation is one thing; the natural origin is quite another.

Whether aluminum orthosilicate as such exists in nature is still a matter of doubt. The rare mineral xenolite has the composition $Al_4(SiO_4)_3$, but it needs further study before its integrity as a species can be fully recognized. At present the weight of evidence seems to be in its favor, but its occurrence is that of a secondary mineral. Among the products of primitive magmas it has not been observed. As regards its ultimate constitution or chemical structure, that question must also be left open. It can be written structurally in several ways; either with each aluminum atom linked with all the SiO_4 groups or with only one atom so connected. In a sense this problem is analogous to that offered by the benzene ring, prism, or nucleus, a conception of which the utility is fully recognized, in spite of outstanding uncertainties. For practical purposes, that is, for the coordination of known facts, expressions like the following are sufficient:







These expressions indicate the observed replaceability of aluminum atoms by other atoms or groups, and have no ulterior significance. So long as their limitations are kept in mind they are useful, but beyond this it would be unreasonable to go. With prolonged discussion and more evidence we may get a deeper insight into the nature of the fundamental molecule; at present, speculation concerning it would be premature. The relations expressed are clear, no matter what others may be revealed in the future. As a working hypothesis, the conception of substitution from a normal salt may be applied to many nonaluminous silicates, as in the magnesian series, the silicates of quadrivalent metals, and so on. These points will be developed in subsequent chapters. In the systematic discussion I shall begin with the orthosilicates, starting with those of aluminum, for the reason that they show most clearly the evidence relative to structure. In a classification of the silicates the starting point would be different, but this is not a classification. The trisilicates will be considered with the orthosilicates, for reasons which are obvious. In the feldspar, zeolite, and mica groups the ortho- and trisilicates can not well be separated.

CHAPTER III.

THE ORTHOSILICATES OF ALUMINUM.

I. THE NEPHELITE TYPE.

If, in accordance with the ideas developed in the preceding chapter, we start out from the normal salt $Al_4(SiO_4)_3$, the first and simplest replacement possible is that of a single aluminum atom by three monads, giving a compound of the general formula $Al_3(SiO_4)_3R'_3$. This formula represents several well-known minerals, and I propose to designate it as the *nephelite type.* At first sight it seems to be reducible to the simpler expression $R'AlSiO_4$, but that expression, as will be seen later, does not indicate all the known relations of the group.

The first three representatives of this type are as follows:

Eucryptite	$Al_3(SiO_4)_3Li_3$
Nephelite	$Al_3(SiO_4)_3Na_3$
Kaliophilite	$Al_3(SiO_4)_3K_3$

These species are all hexagonal, are nearly equal in density, and all gelatinize with hydrochloric acid. The second and typical member of the series has been made synthetically, and is then found to have the composition indicated by the formula. The natural nephelite, however, has a composition which is more exactly represented by the complex formula $R'_8Al_8Si_9O_{34}$, in which a little potassium appears among the components of R′, while there is an excess of silica over the amount required by theory. The potassium is doubtless due to an isomorphous admixture of kaliophilite, and the excess of silica can be explained by the presence of a salt isomeric with albite and having the composition $Al_3(Si_3O_8)_3Na_3$. This replacement of SiO_4 by Si_3O_8 appears to be common among the silicates, and its recognition clears up many discrepancies. In this case one molecule of the trisilicate commingled with fifteen of the ortho-salt will produce the divergence from normal composition shown in the analyses of natural nephelite.

By direct alteration nephelite passes easily into two zeolitic minerals, having the subjoined formulæ:

Hydronephelite	$Al_3(SiO_4)_3Na_2H.3H_2O$
Natrolite	$Al_2(SiO_4)_3Na_2H_4$

In natrolite, two atoms of aluminum have been replaced by $R'_6 = Na_2H_4$, and this species, with others of like origin, falls therefore into another group. Still it is desirable now to call attention to the fact, observed by Doelter,* that natrolite on fusion yields nephelite. The connection between the two species is unmistakable.

Eucryptite and nephelite both alter with great ease into muscovite, a potassium salt of which paragonite is the sodium equivalent. Furthermore, C. and G. Friedel,† by heating finely divided muscovite to 500° in a solution of alkali, obtained nephelite in crystals. From this evidence the formulæ of muscovite and paragonite become directly related to those of the nephelite series, thus:

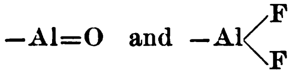
Nephelite	$Al_3(SiO_4)_3Na_3$
Muscovite	$Al_3(SiO_4)_3KH_2$
Paragonite	$Al_3(SiO_4)_3NaH_2$

Physically, the two micas have no resemblance to nephelite, being different in form, slightly denser, and refractory toward acids. The relationship is purely one of chemical type, and is established by the fact of alteration from one into another.

Through muscovite a connection is recognizable between the foregoing species and the two minerals andalusite and topaz, whose simplest formulæ, tripled, may be written as follows:

Topaz	$Al_3(SiO_4)_3(AlF_2)_3$
Andalusite	$Al_3(SiO_4)_3(AlO)_3$

Here we encounter the evidently univalent atomic groups

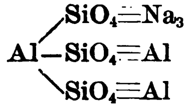


$$-\mathrm{Al}=\mathrm{O} \quad \text{and} \quad -\mathrm{Al}\begin{array}{l}\diagup \mathrm{F}\\ \diagdown \mathrm{F}\end{array}$$

both of which play an important part in various other minerals. The two species, topaz and andalusite, are closely allied crystallographically. They have sensibly identical molecular volumes, and both undergo alteration into muscovite mica. In topaz, as shown by the investigations of Penfield and of Jannasch, hydroxyl commonly replaces a part of the fluorine; hydroxyl and fluorine being clearly isomorphous. The formula given is that of normal topaz, entirely free from alteration.

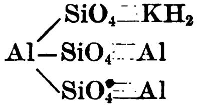
To sum up, we have now eight definite species represented by the fundamental type $Al_3(SiO_4)_3R'_3$, the first substitution from the normal orthosilicate of aluminum. Leaving hydronephelite on one side, because of its water of crystallization, the remaining seven species fall into three subtypes, as follows:

Nephelite.



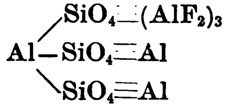
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4}\equiv\mathrm{Na_3}\\ -\mathrm{SiO_4}\equiv\mathrm{Al}\\ \diagdown \mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

Muscovite.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4}\equiv\mathrm{KH_2}\\ -\mathrm{SiO_4}\equiv\mathrm{Al}\\ \diagdown \mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

Topaz.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4}\equiv(\mathrm{AlF_2})_3\\ -\mathrm{SiO_4}\equiv\mathrm{Al}\\ \diagdown \mathrm{SiO_4}\equiv\mathrm{Al}\end{array}$$

symbols which clearly indicate the known chemical relations between the several minerals. In five of the eight examples the simplest pose formulæ have been tripled, for otherwise the relationships which st could not be structurally shown. The correctness of this prolure will appear still more definitely in the consideration of the oups which follow.

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* Allgem. Chem. Mineralogie, p. 183.

† Bull. Soc. Min., XIII, p. 129, 1890.

The species sillimanite is isomeric with andalusite, but the structural aracter of the isomerism is not clear. The minerals kornerupine and ryptotile, which will be considered later, are possibly also representaives of the nephelite type.

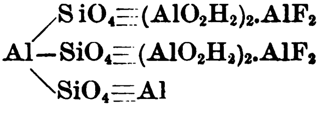
II. THE GARNET-BIOTITE TYPE.

By this title I propose to designate the second series of derivatives from the normal salt $Al_4(SiO_4)_3$, in which two atoms of aluminum have been replaced. The general formula of the type, obviously, is $Al_2(SiO_4)_3R'_6$, and in this series bivalent elements or radicles frequently appear. In natrolite, $R'_6=Na_2H_4$; in biotite, $R'_6=R''_2R'_2$; and in garnet R'_6 are entirely replaced by R''_3. There are, therefore, three subtypes to consider; one in which all the replacing atoms are univalent, one in which all are bivalent, and one intermediate between the other two.

Under the first subtype three species seem definitely to occur, viz:

Natrolite	$Al_2(SiO_4)_3Na_2H$
Dumortierite	$Al_2(SiO_4)_3(AlO$
Zunyite	$Al_2(SiO_4)_3R'_6$*

Natrolite, as we have already seen, may be directly derived from nephelite by alteration. Dumortierite is analogous to andalusite, and like the latter, is orthorhombic. In zunyite R'_6 is composed of the groups $-Al{=}F_2$, $-Al{=}Cl_2$, and $-Al{=}(OH)_2$, with possibly a little $-Al{=}O$, and the mineral thus seems to be chemically related to dumortierite in the same way that topaz is related to andalusite. But topaz and andalusite have crystallographic analogy, while zunyite, being isometric, is quite unlike its chemical congeners. The species evidently needs further study, but at present, if we unite the chlorine in it with the fluorine, it may be provisionally represented by the expression



$$Al\begin{cases} SiO_4\equiv(AlO_2H_2)_2.AlF_2 \\ SiO_4\equiv(AlO_2H_2)_2.AlF_2 \\ SiO_4\equiv Al \end{cases}$$

This formula expresses the facts which are now available, but is conclusive. Its isometric character, however, helps to connect zun with the garnet and sodalite groups, as has been shown by Brögge

In the second subtype, when R'_6 is partly composed of bivalent partly of univalent atoms, two species may be placed, thus:

Prehnite	$Al_2(SiO_4)_3Ca_2$
Biotite	$Al_2(SiO_4)_3M$

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* Groth's formula, generalized.

† Zeit. Kryst. Min., XVIII, p. 209.

Possibly the tetragonal sarcolite, which has the general formula of a garnet with the lime partly replaced by soda, may fall here also; but the analyses of this mineral are unsatisfactory, and its relations are still uncertain. Biotite will be more fully considered in the special chapter devoted to the mica group. Prehnite, according to Doelter,* decomposes on fusion, yielding the same products as garnet.

Under the third subtype of this series we find the garnet group itself, together with epidote and several related species. The sodalite group is also akin to garnet and to the second subtype, and will be considered in this connection a little later. Under the generic term garnet several species are included, all being isometric and strictly isomorphous, in which magnesium, calcium, and ferrous iron replace one another, while chromium, aluminum, and ferric iron are also equivalent terms. Thus we have:

Grossularite	$Al_2(SiO_4)_3Ca_3$
Pyrope	$Al_2(SiO_4)_3Mg_3$
Almandite	$Al_2(SiO_4)_3Fe''_3$
Spessartite	$Al_2(SiO_4)_3Mn_3$
Andradite	$Fe_2(SiO_4)_3Ca_3$
Ouvarovite	$Cr_2(SiO_4)_3Ca_3$

To these may be added schorlomite, a garnet in which titanium occurs both as part of the acid, that is, with TiO_4 replacing SiO_4, and also as Ti''' among the triad bases, equivalent to aluminum. The monoclinic partschinite, isomeric with spessartite, also falls into this group.

In the epidote group, at least four species appear, one, zoisite, being orthorhombic, while the other three are monoclinic. These species are characterized by the bivalent group of atoms $=\dot{A}l-OH$, thus:

Zoisite	$Al_2(SiO_4)_3Ca_2(AlOH)$
Epidote, *a*	$Al_2(SiO_4)_3Ca_2(AlOH)$
Epidote, *b*	$Fe_2(SiO_4)_3Ca_2(FeOH)$
Piedmontite	$(AlMn)_2(SiO_4)_3Ca_2(AlOH)$
Allanite	$(AlCeFe)_2(SiO_4)_3(CaFe)_2(AlOH)$

or, in general, as compared with garnet,

Garnet	$R'''_2(SiO_4)_3R''_3$
Epidote	$R'''_2(SiO_4)_3R''_2(R'''OH)$

The facts that garnet alters into epidote and that the two minerals are often associated give emphasis to the formulæ. For epidote, however, an alternative formula is possible, in which the hydroxyl is supposed to be united with calcium rather than with aluminum. But epidote is a peculiarly stable mineral, while the group $-Ca-OH$ would imply instability and easy alteration. The alternative formula, therefore, is improbable, although it would ally epidote more easily with anorthite, which is a product of its fusion.

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* Allgem. Chem. Mineralogie, p. 183.

Although garnet, as a rule, is unattacked by acids, and epidote is only in part decomposable, both species are so broken up by strong ignition as to be readily acted upon by hydrochloric acid, with separation of gelatinous silica. According to Doelter and Hussak,[*] garnet yields upon fusion sometimes anorthite and an olivine; or meionite, augite, and olivine; or melilite and anorthite; and occasionally spinel. Epidote, says Doelter,[†] yields lime-augite and anorthite, and prehnite behaves like garnet. These facts indicate analogies between the several species named, but are not easy of complete interpretation. The different products observed may be due in part to a direct splitting up of the original insoluble mineral into soluble species like anorthite and a lime-olivine, and in part to secondary reactions taking place during the prolonged fusion and cooling of the resultant magma. In other words, two sets of phenomena are probably involved in the observations, and it is impossible at present to distinguish between them. The first set alone is immediately relevant to the constitutional question now before us.

In the four species sodalite, haüynite, nosite, and lazurite we have a group of minerals which Brögger has classified as alkali garnets.[‡] Like garnet, they are all isometric, and they are characterized by the presence of the bivalent groups $=Al-Cl$, $=Al-SO_4-Na$, and $=Al-S-S-S-Na$. There are also artificial products, ultramarines, in which the groups $=Al-S-S-Na$ and $=Al-S-Na$ appear. Adopting Brögger's formulæ, which are preferable to those formerly proposed by myself,[§] these species may be written as follows:

Sodalite	$Al_2(SiO_4)_3Na_4(AlCl)$
Haüynite	$Al_2(SiO_4)_3Na_2Ca(AlSO_4Na)$
Nosite	$Al_2(SiO_4)_3Na_4(AlSO_4Na)$
Lazurite	$Al_2(SiO_4)_3Na_4(AlS_3Na)$

They fall, therefore, properly under the second subtype, but are considered at this point on account of their analogies with garnet.

Through these species, and especially through sodalite, a connection with several other minerals is established. Sodalite occurs in elæolite syenytes, and is evidently derived from nephelite, and like the latter it yields natrolite, hydronephelite, and muscovite by alteration. Furthermore, C. and G. Friedel,[||] on heating powdered muscovite with soda solution and sodium chloride at a temperature of 500°, obtained sodalite artificially, although nephelite was probably first formed as an intermediary, and the two species were commingled in the product.

The two hexagonal species, cancrinite and microsommite, are also, like sodalite, undoubtedly derivatives of nephelite, but their formulæ are rather uncertain. Cancrinite approximates to the composition

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[*] Allgem. Chem. Mineralogie, p. 182.

[†] Allgem. Chem. Mineralogie, p. 183.

[‡] Brögger and Bäckström, Zeit. Kryst. Min., XVIII, p. 209.

[§] Bull. U. S. Geol. Survey No. 42, p. 38.

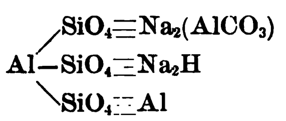
[||] Bull. Soc. Min., XIII, p. 183.

$Al_2(SiO_4)_3Na_4H(AlCO_3)$, in which a little soda is replaced by lime, and the univalent group $-Al=CO_3$ may be partly substituted by $-Al=SiO_3$. Microsommite, according to the published analyses, varies in composition widely, containing always potassium, and having a notabie proportion of chlorine and sulphuric acid among its constituents. If, however, we assume in it the univalent radicles $-Al=Cl_2$ and $-Al=SO_4$, its composition reduces easily to the form $Al_2(SiO_4)_3(NaK)_3Ca(Al(SO_4.Cl_2))$, like cancrinite, both species having then the composition of the general type $Al_2(SiO_4)_3R'_6$. The theory as proposed, then, assumes univalent complex radicles for cancrinite and microsommite, and bivalent radicles for the sodalite group, thus:

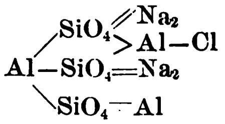
In cancrinite group.	*In sodalite group.*
$-Al=Cl_2$	$=Al-Cl$
$-Al=SO_4$	$=Al-SO_4-Na$
$-Al=CO_3$	$=Al-S_3-Na$
$-Al=SiO_3$	

and the typical structures are as follows:

Cancrinite.



Sodalite.



Concerning these formulæ and the peculiar uni- and bivalent radicles assumed in them, there are arguments both for and against. The assumption of a group $-Al=SiO_3$, equivalent to and replacing $-Al=CO_3$, is clearly suggested by the experiments of Lemberg,* who, by the action of sodium silicate solution upon elæolite, obtained a compound which he designates as a cancrinite containing Na_2SiO_3 in place of Na_2CO_3. By similar reactions with sodium carbonate he produced a substance having the composition of true cancrinite. Hence, whatever the ultimate molecular structure of cancrinite may be, we are amply justified in assuming in it the replaceability of CO_3 by SiO_3.

These experiments fairly represent a large number of like kind which are due to Lemberg, and which may be found recorded in his various papers. Some of these will be cited later, but a reference to the work of his colaborer Thugutt† is in place at this point. Starting from a hydrated nephelite, artificially prepared from kaolin, Thugutt succeeded in producing a large series of compounds analogous to sodalite, in which the original silicate had taken up, at moderately high degrees of heat and pressure, various other salts of sodium, such as the chlorate, selenate, formate, oxalate, and so on. These compounds, however, are all hydrated, and so differ from the natural minerals of the sodalite group, and they are regarded by Thugutt as formed by molecular union. Following Lemberg, he regards sodalite as a molecular compound of nephelite with sodium chloride, and taking his series of compounds throughout, he looks upon the sodium salts which have been added to the fundamental silicate as equivalent in function to water of crystallization. In favor of this view he cites many arguments, some of which are entitled to considerable weight. Thus, when sodalite is ignited NaCl is driven off, whereas if the chlorine were united with aluminum $AlCl_3$ should be expelled. Similarly, by the action of water alone, sodium chloride can be split off from the sodalite molecule, thus indicating a looser form of union than the proposed structural formulæ show.

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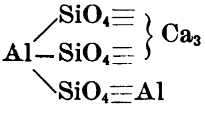
* Zeitsch. Deutsch. Geolog. Gesell., 1885, p. 962.

† Mineralchemische Studien, Dorpat, 1891.

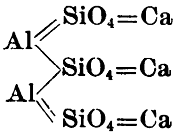
But what is molecular union? To this question there is no satisfactory answer, and even in the case of water of crystallization the term is only a confession of ignorance. Unless we assume the existence of two kinds of chemical union, it means merely that the structural linking is unknown, and that the problem is laid on one side, conveniently labeled for future reference. The constitutional formulæ here adopted for sodalite and cancrinite are intended to give a provisional solution of the problem in their particular cases, and to express the genetic relationships with nephelite on the one hand and the crystallographic analogy with garnet on the other. The objections to them raised by Thugutt are serious, but not absolutely conclusive. When sodium chloride is split off from sodalite the mechanism of the reaction is quite unknown, and the relative affinities in the molecule are quite unstudied. Until these are understood the objections raised by Lemberg, Thugutt, and others are not fatal. Furthermore, the presence of a group $=Al-Cl$ does not imply, as Thugutt supposes, the splitting off of $AlCl_3$ by heat. To effect such a decomposition three molecules of sodalite would have to be broken up, and there is no probability that such a disintegration could occur. At all events the formulæ proposed fulfill a definite purpose, even though they are not finally established. They express known relations, but not necessarily all the relations which the future may reveal. The facts that the sodalite-cancrinite minerals are derivable from nephelite, and that nephelite is again derivable from them, are unquestionable.

Taking now the formula of a typical garnet, $Al_2(SiO_4)_3Ca_3$, the question of its molecular structure remains to be considered. Regarding it as a derivative of the normal salt $Al_4(SiO_4)_3$, it may be written in at least two ways, thus:

1.



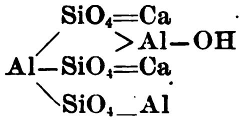
2.

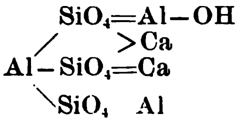


That is, isomerism is possible; and of the two species partschinite and spessartite, one may belong to one type and the other to the other.

In the first expression there is still a replaceable atom of aluminum, in the second expression none; in the first, at least, one calcium atom must link two SiO_4 groups, while in the other no such linkage occurs; and these facts may be connected with others. For example, garnet alters into mica; and the mica group, as will be seen later, contains members in which the third aluminum atom is replaced. This points at once to the first type of formula as preferable, and the alterability of garnet into epidote brings the latter mineral into the same category.

Zunyite and sodalite, being isometric, should also follow garnet; but derivatives of the second type are theoretically possible and may exist. Even under the first type alone, isomerism is conceivable, and the orthorhombic zoisite may be contrasted with the monoclinic lime epidote as follows:

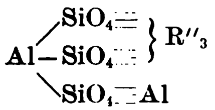




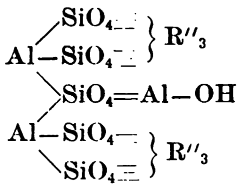
even though we can not assign either species to either formula definitely. My object here is merely to show that the formulæ have properties by virtue of which they are able to express known differences.

Additional evidence for the formula assigned to garnet is furnished by the composition of vesuvianite, which is most simply represented as formed by the coalescence of two garnet molecules, with elimination of silica. The following formulæ express this relation, and also a relation to epidote, quite perfectly:

Garnet.



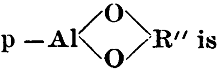
Vesuvianite.



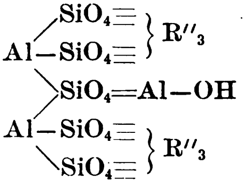
If in vesuvianite $R''_6=Ca_5Mg$, this formula gives for the composition of the typical mineral:

SiO_2	38.38
Al_2O_3	19.55
CaO	35.81
MgO	5.12
H_2O	1.14
	100.00

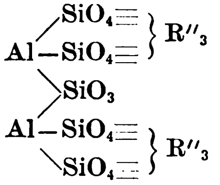
This agrees well with the published analyses, if we remember that ferric iron may partly replace aluminum, and that fluorine sometimes replaces hydroxyl. It is also sustained by the facts that garnet and vesuvianite often occur in contact limestones under similar conditions of genesis; that vesuvianite alters into garnet, and also, like garnet, into micas and chlorites; and that both species, as shown by Doelter,[*] yield essentially the same products upon fusion. The analogies connecting them are remarkably suggestive and complete, and the formulæ here proposed render those analogies intelligible. In the Swedish "mangan-idocrase" a salt occurs which is doubtless the vesuvianite equivalent of spessartite, but the compound in a pure state is unknown.

Two additional species, melilite and gehlenite, which, like vesuvianite, are also tetragonal, may perhaps be best considered at this stage of the discussion. For melilite, the analyses are somewhat discordant; but on the whole they agree best with Groth's formula $(CaMgNa_2)_6(AlFe)_2Si_5O_{19}$. This may be written so as to resemble the formula of vesuvianite, but with the linking SiO_4 group replaced by the bivalent SiO_3. For gehlenite, the empirical formula $Ca_3Al_2Si_2O_{10}$ is commonly assumed, but a careful comparison of the published analyses has convinced me that it is not entirely satisfactory. Most of the analyses show appreciable amounts of water, but this may be due to alteration; for the artificial gehlenite, prepared by the igneous method, is nonhydrated. A different formula, which relates gehlenite to melilite and vesuvianite, seems to be preferable; and such a formula is empirically $Ca_7MgAl_4Si_5O_{24}$. In this the univalent group  $-\mathrm{Al}{<}\overset{\mathrm{O}}{\underset{\mathrm{O}}{}}{>}\mathrm{R}''$ is to be assumed, which occurs also among the clintonite micas, and which, in natural gehlenite, may be replaced in part by $-\mathrm{Al}=(\mathrm{OH})_2$. On this basis the three species are comparable as follows:

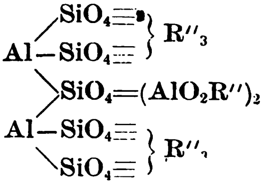
Vesuvianite.



Melilite.



Gehlenite.



These symbols are not absolutely unobjectionable, but they are useful for purposes of correlation. Gehlenite alters into garnet, melilite sometimes occurs among the products of fusion of garnet, and the formulæ suggest such relations. Furthermore, Lemberg[†] has shown that gehlenite, heated to 200° with a solution of potassium carbonate, gives calcium carbonate and a product having the composition of a potash mica; while similar treatment with sodium carbonate converts the mineral into cancrinite. Gehlenite, garnet, cancrinite, and muscovite are therefore related to one another, and this fact is expressed by the formulæ proposed. In melilite the calcium is partly replaced by sodium, and in some gehlenites obtained from furnace slags the same replacement has been observed.*

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[*] Allgem. Chem. Mineralogie, p. 183.

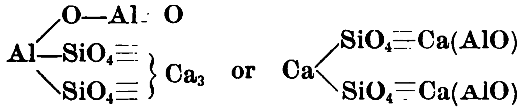
[†] Zeitsch. Deutsch. Geolog. Gesell., 1892, p. 237.

At the Orawitza locality, gehlenite occurs in rolled pebbles containing grains of vesuvianite. As this gehlenite contains little or no water, we may compare Janovsky's analysis of it† with the results obtained from calculation, both with the formula $Ca_3Al_2Si_2O_{10}$, and with the new formula $Al_2(SiO_4)_5R''_6(AlO_2R'')_2$, when $R''_8=Ca_7Mg$.

The results are as follows:

	Janovsky.	Old formula.	New formula.
SiO_2	32.39	30.77	32.05
Al_2O_3	18.53	26.15	21.80
Fe_2O_3	1.25		
FeO	3.61	43.08	
CaO	37.65		41.88
MgO	6.69		4.27
Ign	.51	....	....
	100.63	100.00	100.00

Neither formula compares perfectly with the analysis, but the new is rather better than the old. With some other analyses this advantage is reversed. We need new data, based upon purer and more definite material than seems to have been as yet collected. If the old formula should be sustained, then it might be written structurally in either of two ways, thus:



$$Al\begin{cases} O-Al=O \\ SiO_4\equiv \\ SiO_4\equiv \end{cases}Ca_3 \quad \text{or} \quad Ca\begin{cases} SiO_4=Ca(AlO) \\ SiO_4=Ca(AlO) \end{cases}$$

The first formula would serve to connect gehlenite with garnet and the micas, while the second represents a derivative of calcium orthosilicate and fails to indicate the various relationships of the mineral to other species of this group. Neither formula, however, is so suggestive as the one which is based upon the type of vesuvianite.

Another alternative is offered by the theory of Vogt,‡ who regards melilite and gehlenite as varying mixtures of two end products; one, the "gehlenite silicate," $R'''_2R''_3Si_2O_{10}$, and the other, åkermannite, $R''_4Si_3O_{10}$. The last compound is a basic silicate, found in slags, which needs further study. Vogt's theory is plausible, and, if established, will take the two species in question, gehlenite and melilite, out of the present category as related minerals to vesuvianite and garnet.

The little-known mineral arctolite is possibly another member of this group, with affinities toward prehnite. Its composition is fairly expressed by the formula

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* See Hintze, Handbuch der Min., p. 310.

† Dana's System of Mineralogy, 6th ed., p. 476.

‡ Neues Jahrb., 1892, II, p. 73.

$$Al_2(SiO_4)_3CaMgH_2$$

which is that of prehnite with CaMg in place of Ca_2. The integrity of this species, however, is not yet fully established.

III. THE FELDSPARS AND SCAPOLITES.

Although orthosilicic and trisilicic acids are technically distinct, and from a chemical point of view should be studied separately, their salts containing aluminum occur in such a variety of mixtures that in several groups of minerals the two acids must be considered as mutually equivalent, and their compounds discussed together. Two such groups, closely allied, are the feldspars and the scapolites.

For each of these groups the theory developed by Tschermak has met with general acceptance. In the case of the feldspars, Tschermak was undoubtedly anticipated in great part by Hunt, Waltershausen, and others, but he gave to the theory its most precise statement, and to him its final establishment is due. According to this theory the triclinic plagioclase feldspars consist of albite, $AlNaSi_3O_8$, and anorthite, $Al_2Ca(SiO_4)_2$; which, commingled in various proportions, give the intermediate oligoclase, labradorite, andesite, and so on. There are also the triclinic microcline and its monoclinic equivalent, orthoclase, both represented by the formula $AlKSi_3O_8$, and the barium feldspars, such as hyalophane, which may be regarded as mixtures of orthoclase with a barium salt analogous to anorthite in composition. Microcline and orthoclase, from a chemical point of view, may be considered as isomers; and so also may albite and soda-orthoclase; but the nature of the isomerism is not clear. It may be due to the structure of the salt as such, or to the existence of two isomeric acids $H_4Si_3O_8$, and both possibilities are conceivable. For present purposes this problem may be left outstanding, and our attention can be confined to the two typical compounds, anorthite and albite. In the discussion, later, of the species eudidymite and epididymite, the question of isomeric trisilicates will come up.

For the scapolite series Tschermak has elaborated a theory which is closely parallel to that of the feldspars. These tetragonal minerals are shown to be most easily interpretable as mixtures of two end compounds, meionite, $Al_6Ca_4Si_6O_{25}$, and marialite, $Al_3Na_4Si_9O_{24}Cl$. Neither end compound has yet been found in nature quite free from the other; but the variations in composition, in optical character, etc., are all accounted for, and the theory, so far as it goes, is satisfactory. I have tentatively examined some possible alternative hypotheses, and none of them fulfills all necessary conditions so well as this scheme of Tschermak's.

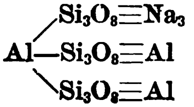
Upon studying the feldspars and scapolites more closely, certain analogies appear other than those indicated by the parallelism of the two series. Both groups of minerals are easily alterable, and both yield *kaolin* as a final product of the change. Furthermore, both alter into muscovite, or pinite, which is only an impure pseudomorphous mica; and kaolin, crystallographically, has close relations with the mica family. Feldspars, scapolites, muscovite, and kaolin are therefore presumably connected, and the structural formulæ of the minerals should render the relationship apparent.

The empirical formulæ to be considered are now as follows:

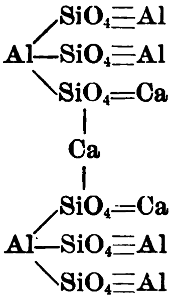
Albite	$AlNaSi_3O_8$
Anorthite	$Al_2CaSi_2O_8$
Meionite	$Al_6Ca_4Si_9O_{25}$
Marialite	$Al_3Na_4Si_9O_{24}Cl$
Muscovite	$Al_3KH_2Si_3O_{12}$
Kaolin	$Al_2H_4Si_2O_9$

For muscovite the constitution has already been indicated; and this clew, together with the general hypothesis of derivation from normal salts, enables us to correlate all six of the formulæ given. To do this it is necessary to triple the formulæ of albite and anorthite, and we have the following expressions:

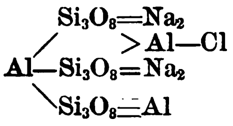
Albite.



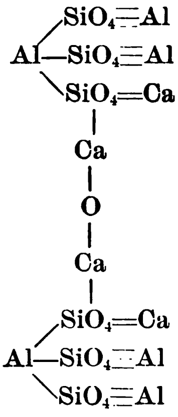
Anorthite.



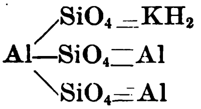
Marialite.



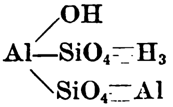
Meionite.



Muscovite.



Kaolin.

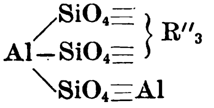


On this basis anorthite becomes the calcium equivalent of nephelite, which latter species is also alterable into kaolin. Again, garnets are known to alter into feldspars and scapolite; and, according to Brauns,* in the alteration of diabase, prehnite and epidote are sometimes derived from anorthite. These species, therefore, are all connected by numerous cross relations, all emphasizing one another and pointing to a community of molecular type. I have already called attention to the facts that anorthite and meionite occur among the products of fusion of garnet, and these data fit in well with the others. So far the formulæ are highly suggestive, but as yet they do not indicate the mechanism of the reaction by which a trisilicate feldspar breaks down into kaolin, and they need development in that direction.

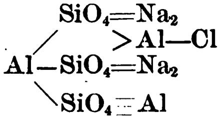
Closely allied to the feldspar in its petrographic relations is the isometric mineral leucite, $AlKSi_2O_6$. Empirically it seems to be a metasilicate, and is commonly so regarded, but it may easily be conceived as a mixed salt, containing ortho- and trisilicate molecules. By alteration it yields orthoclase, nephelite, muscovite, and kaolin, and the pseudo-leucite of Magnet Cove has been shown by J. F. Williams to consist of orthoclase and elæolite intimately commingled.† This case probably represents the typical breaking up of leucite, the formation of kaolin or of muscovite in other instances being due to secondary reactions. On the other hand, C. and G. Friedel‡ have obtained leucite synthetically from muscovite as a starting point, orthoclase and nephelite being produced at the same time; and Lemberg,§ in his experiments, has transformed leucite into sanidine, anorthite, and microsommite, and also into andesine. In a later paper‖ Lemberg describes the action upon various silicates of the salt Na_2SiO_3, $8H_2O$, at 200° under pressure, kaolin, albite, elæolite, leucite, and analcite all yielding a silicate-cancrinite containing SiO_3 in place of CO_3. These facts connect the several species together, but to their explanation the empirical expression $AlKSi_2O_6$ gives no clew. A formula for leucite, to be satisfactory, must be a multiple of this, and several such multiples fulfill the conditions of the problem.

The isometric form of leucite suggests at once a relation with garnet and the sodalite group, and this can be indicated by the quadrupled formula $Al_4K_4Si_8O_{24}$. We then have, as a distinct possibility, the following series of molecules:

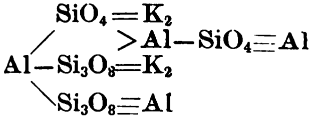
Garnet.



Sodalite.



Leucite.



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* Neues Jahrbuch, 1892, II, p. 1.

† Ann. Rept. Geol. Survey of Arkansas, 1890, II, p. 267 et seq.

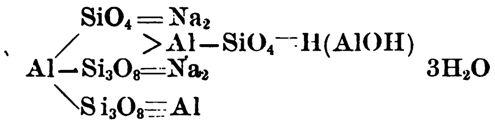
‡ Bull. Soc. Min., XIII, p. 134, 1890.

§ Zeitsch. Geol. Gesell., XXVIII, pp. 611-615, 1876.

‖ Zeitsch. Geol. Gesell., pp. 961-2, 1885.

Upon this basis leucite is clearly reduced to the uniform type of the minerals to which it is related crystallographically, and also of those into which it alters; but the formula proposed can not be regarded as final. It is offered here only as a first approximation toward answering the questions which are suggested, and is therefore subject to modification in the future.

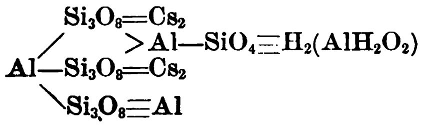
Closely allied to leucite is another isometric mineral, analcite, which, empirically, has the composition $AlNaSi_2O_6,H_2O$. This species alters, like leucite, into feldspar, and an alteration into prehnite is also recorded.[*] Furthermore, Lemberg has shown, in the papers already cited, that leucite, by the action of soda solutions, may be transformed into analcite, and that analcite, by similar treatment with potash, yields leucite again. With these facts in view, analcite may be written



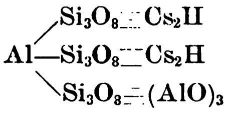
one-fourth of the water being regarded as constitutional. This last supposition, however, needs to be checked by careful experiments upon dehydration, for the data now on record are not absolutely conclusive.[†] A change in this detail would modify the formula given, but would not affect its general type.

Still another isometric mineral, pollucite, should possibly be considered here. Two empirical formulæ deserve to be regarded: one, based upon analyses of the Elba mineral, and given by Groth, $H_2Cs_2Al_2Si_5O_{15}$; the other, deduced by Wells[‡] for the Maine pollucite, $H_2Cs_4Al_4Si_9O_{27}$. Both formulæ give metasilicate ratios, but both are reducible to the type of leucite and analcite, thus:

Elba.



Maine.



Neither formula can be regarded as conclusive, and their only value here is to show that pollucite is not necessarily a metasilicate, and that it can be represented as similar in constitution to the minerals with which it is morphologically allied. Wells's analyses are probably the better; but the formula drawn from the Elba pollucite indicates the closer analogy to leucite and analcite.

Although kaolin, mineralogically, is not a member of the feldspar group, it is properly discussable here as a derivative. The formula assigned to it in the foregoing pages is not unimpeachable, but it suggests its relations to the feldspars and micas, and also represents the fact that the water in it is wholly constitutional. In fact, the mineral is stable far above the ordinary temperatures of dehydration, so that the water can be regarded only as an essential part of the molecule.

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[*] Dana's System of Mineralogy, 6th ed., p. 598.

[†] Compare Hersch, Der Wassergehalt der Zeolithe, Zürich, 1887.

[‡] Am. Jour. Sci. (3) XLI, p. 213, 1891.

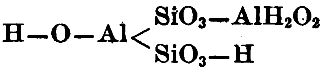
In addition to the formula proposed for kaolin, the following expressions are possible without assumption of any higher molecular weight:

(1) $\mathrm{Si_2O_7.H_4(AlO)_2}$

(2) $\mathrm{Si_2O_7.H_2(AlOH)_2}$. Brauns's.

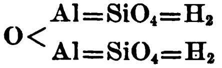
(3) $\mathrm{Si_2O_5.(AlH_2O_2)_2}$. Groth's.

(4)



$$\mathrm{H{-}O{-}Al}\left<\begin{array}{l}\mathrm{SiO_3{-}AlH_2O_2}\\ \mathrm{SiO_3{-}H}\end{array}\right.$$

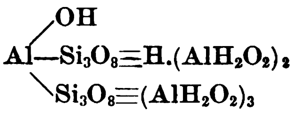
(5)



$$\mathrm{O}\left<\begin{array}{l}\mathrm{Al{=}SiO_4{=}H_2}\\ \mathrm{Al{=}SiO_4{=}H_2}\end{array}\right.$$

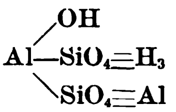
If the formula be tripled, then kaolin may be written as a basic trisilicate, thus:

(6)



$$\mathrm{Al}\left<\begin{array}{l}\mathrm{OH}\\ \mathrm{Si_3O_8{\equiv}H.(AlH_2O_2)_2}\\ \mathrm{Si_3O_8{\equiv}(AlH_2O_2)_3}\end{array}\right.$$

Of all these symbols only the last and the one originally chosen indicate the relations between kaolin and its parent species. As for these two, the formula



$$\mathrm{Al}\left<\begin{array}{l}\mathrm{OH}\\ \mathrm{SiO_4{\equiv}H_3}\\ \mathrm{SiO_4{\equiv}Al}\end{array}\right.$$

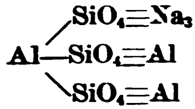
is the simpler, and would seem to represent the greater stability. Kaolin, under ordinary circumstances, is scarcely attacked by the strongest hydrochloric acid, a fact which seems to be most in harmony with the orthosilicate expression. That expression, therefore, is to be preferred; at least until more positive evidence is attainable. After dehydration at low redness, kaolin is completely decomposable by hydrochloric acid, but the ignited mass contains no silica soluble in sodium carbonate solution. These facts, developed by experiments made under my direction by Mr. George Steiger, seem to indicate the formation of a salt $\mathrm{Al_3Si_2O_7}$ as the result of ignition, but other interpretations are possible. The data are given here simply as data, which may become available for a fuller discussion of the problem by and by. It will be seen later, when the other clays are considered, that their formulæ are in harmony with that chosen for kaolin.

IV. THE NORMAL ZEOLITES.

By this title is indicated a well-defined group of hydrous silicates, unmistakably related to nephelite and the feldspars, and for which the term *feldspathic zeolites* would be equally appropriate. A few zeolitic species, ptilolite, mordenite, laubanite, etc., are excluded from the present scheme, as being from a chemical point of view more properly placed elsewhere.

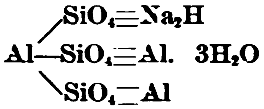
Three of the minerals in this group have already been mentioned. namely, hydronephelite, natrolite, and analcite. All of these occur as alteration products of elæolite or nephelite,* and natrolite yields nephelite again upon fusion. Natrolite and analcite are both derivable by natural processes from albite;† analcite, as shown in the preceding section, yields feldspathic pseudomorphs, and the relations of analcite to leucite are beyond controversy. From sodalite, both natrolite and hydronephelite may be generated, and from nephelite, by artificial means, Doelter has produced analcite and natrolite.‡ All of these relations, with others, both morphological and genetic, are covered by the formulæ which have already been developed, but which, in part at least, may be advantageously repeated here. Thus we have:

Nephelite.



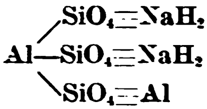
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4\equiv Na_3}\\ \!-\!\mathrm{SiO_4\equiv Al}\\ \diagdown \mathrm{SiO_4\equiv Al}\end{array}$$

Hydronephelite.



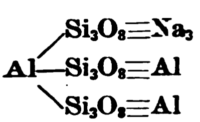
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4\equiv Na_2H}\\ \!-\!\mathrm{SiO_4\equiv Al.\ 3H_2O}\\ \diagdown \mathrm{SiO_4\equiv Al}\end{array}$$

Natrolite.



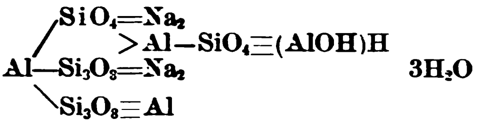
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4\equiv NaH_2}\\ \!-\!\mathrm{SiO_4\equiv NaH_2}\\ \diagdown \mathrm{SiO_4\equiv Al}\end{array}$$

Albite.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{Si_3O_8\equiv Na_3}\\ \!-\!\mathrm{Si_3O_8\equiv Al}\\ \diagdown \mathrm{Si_3O_8\equiv Al}\end{array}$$

Analcite.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4{=}Na_2}\\ \qquad\quad >\mathrm{Al{-}SiO_4\equiv(AlOH)H}\\ \!-\!\mathrm{Si_3O_8{=}Na_2} \qquad\qquad\qquad\qquad \mathrm{3H_2O}\\ \diagdown \mathrm{Si_3O_8\equiv Al}\end{array}$$

For the full significance of these expressions the previous sections must be consulted; the analcite formula being correlated with the formulæ of garnet, leucite, and the minerals of the sodalite group.

In a similar way, but rather less completely, many zeolitic minerals may be connected with anorthite, the calcium end of the plagioclase feldspar series. For example, by heating anorthite with freshly precipitated silica and carbonic acid water at 200°, Doelter obtained heulandite.§ The same investigator, after fusion of various zeolites and subsequent slow cooling, found anorthite among the substances produced by chabazite, heulandite, stilbite, scolecite, laumontite, and thomsonite.‖ In some cases anorthite was the chief product of fusion; in others it was subordinate to something else. Again, by various wet reactions, some of them unfortunately involving several stages, Lemberg has generated analcite¶ from chabazite, gmelinite, laumontite, harmotome, phillipsite, stilbite, and heulandite, in some cases studying several varieties of the same species. It is clear, therefore, that the connection between the zeolites and the feldspars is unquestionable, and it only remains to work out the details for each individual mineral. The fundamental relations between the two groups have been recognized by many writers; but their interpretations have been diverse.

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* See Brögger, Zeit. Kryst. Min., XVI. p. 223 et seq.

† Neues Jahrb., 1892, II. p. 1; Brauns.

‡ Neues Jahrb., 1890, I, p. 134.

§ Neues Jahrb., 1890, I, p. 128. et seq.

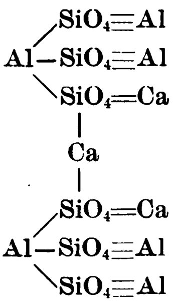
‖ Neues Jahrb., 1890. I, p. 118. and Allgem. Chem. Mineralogie. p. 183.

¶ Zeitsch. Geolog. Gesell., 1885, p. 959 et seq.

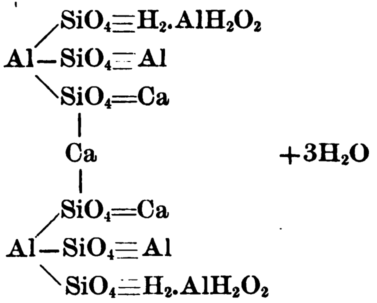
In the systematic treatment of the zeolites, the most serious difficulty is found in the hydration of the several species. To determine in any case what part of the water is constitutional and what crystalline is not easy, and no fixed criterion exists upon which judgment may be based. Water which is retained by a mineral above 300° of temperature is almost certainly constitutional; water lost at or below 100° is probably water of crystallization; but between the two there is a range of considerable vagueness. There is, however, one datum which has claims to high consideration. Certain zeolites, at various temperatures between the limits indicated, lose water which is regained without change of crystalline character upon subsequent exposure of the minerals to moist air, and this, as has been urged by several authorities, should be regarded as water of crystallization. By considerations of this kind we can be guided to some extent, but beyond them each zeolite must be studied independently, in the light of such collateral evidence as may be available. For some species the evidence is full, for others it is meager; but such as it is it will appear in the systematic discussion following.

In a recent publication* I have shown how all of the normal zeolites may be formulated as substitution derivatives of the feldspars, although in some cases alternative formulæ are readily conceivable. Thus, from anorthite several species are directly derivable, as follows:

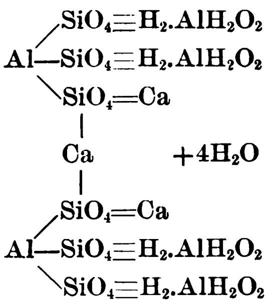
Anorthite.



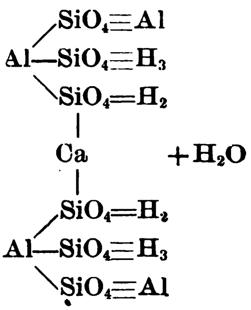
Thomsonite.



Gismondite.



Foresite.



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* Am. Jour. Sci. (3), XLVIII, p. 187, 1894.

Of these formulæ, the last one, that of foresite, is uncertain, on account of great variations in the published analyses. It is therefore to be regarded as approximate only, and as peculiarly subject to revision. For gismondite the composition is empirically that given by Dana, and the calcium is partly replaceable by potassium. Gismondite is said to give off one-third of its water at 100°, and in the formula that amount is represented as water of crystallization. For thomsonite the evidence is much fuller. Here four-sevenths of the water is regarded as constitutional, a proportion which is fairly in accord with the data by Damour and by Hersch, as cited in Dana.* In nature thomsonite often occurs as a derivative of elæolite, while, according to Doelter (loc. cit.), it yields anorthite upon fusion. In some cases thomsonite, variety mesole, carries an excess of silica, which may be attributed to an admixture of trisilicate groups; that is, to Si_3O_8 replacing SiO_4. In a thomsonite derived from a plagioclase feldspar this should be expected, and so also should the almost invariable replacement of a part of the calcium by sodium. Nonsodic thomsonite exists, but is probably rare. A thomsonite containing Ca_2Na_2 in place of Ca_3 would have the following theoretical composition:

SiO_2	37.27
Al_2O_3	31.68
CaO	11.59
Na_2O	6.42
H_2O	13.04
	100.00
$\frac{3}{7}H_2O$ (water of crystallization)	5.59

This agrees well with published analyses, so that the formula proposed satisfies all the conditions imposed by the evidence and also by the general substitution theory.

In scolecite, $Al_4Ca_2H_8(SiO_4)_6.2H_2O$, we find a zeolite with relations to natrolite on one side and to anorthite on the other. Approximately one-third of its water is given off at temperatures below 300°, to be taken up again in moist air, and on fusion, according to Doelter, it yields anorthite. By the slow action of soda solutions it is transformed into natrolite and mesolite, while natrolite, by means of calcium chloride, is convertible into scolecite.† Mesolite, which is intermediate between natrolite and scolecite, may be regarded as a mixture of the two, or it may be formulated as an independent compound. Written on the anorthite type, scolecite and mesolite become

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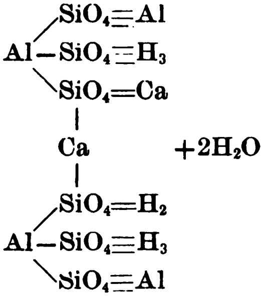
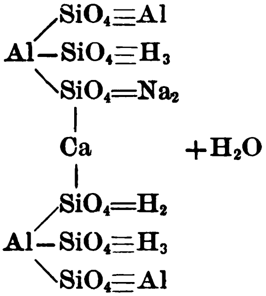
* Syst. Min., 6th ed., p. 608. Compare Hersch, Der Wassergehalt der Zeolithe, Zürich, 1887.

† Lemberg, Zeitsch. Geol. Gesell., XXVIII, p. 551, 1876.

Scolecite.

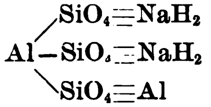


Mesolite.

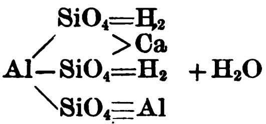


the two species being possibly miscible. On the other hand, the scolecite formula may be halved and correlated with that of natrolite, thus:

Natrolite.



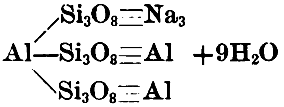
Scolecite.

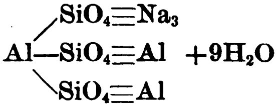


Both formulæ for scolecite satisfy the evidence, but between them it is difficult to decide. The existence of mesolite may perhaps turn the scale in favor of the anorthite structure.

By the action of barium chloride solution upon an artificial natrolite, Lemberg* obtained a barium compound which may be the equivalent of scolecite. It is also near the tetragonal edingtonite in composition. The evidence as to the constitution of edingtonite, however, is very imperfect, and dehydration data are entirely wanting. It may also be represented as the barium equivalent of the monoclinic gismondite, the difference in form being due to a difference of combination on the part of the water. At all events, it is highly probable that edingtonite is a derivative of a barium feldspar.

In the rhombohedral zeolites, gmelinite, levynite, and chabazite with its varieties, the ratios are approximately metasilicate, but somewhat variable. In this respect they resemble the feldspars, and the pseudometasilicate character is ascribable to mixtures of ortho- and trisilicates, with sometimes one and sometimes the other predominating. Gmelinite is essentially a sodium zeolite, with comparatively little or no lime in its composition, and when lime is present it can be attributed to a hydrous anorthite with 18 molecules of water. Apart from the lime, gmelinite is easily interpreted as a mixture of two silicates of precisely similar chemical type; one an albite, and the other its orthosilicic equivalent, thus:





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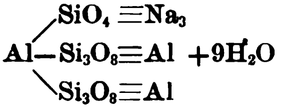
[*] Zeitsch. Geol. Gesell., XXVIII, p. 553, 1876.

Calculating for mixtures in the ratios of 1:1 and 2:1, we get from these formulæ the following composition of gmelinite, in comparison with analyses by Rammelsberg and by Pirsson:*

	Rammelsberg.	Pirsson.	1:1.	2:1.
SiO_2	46.48	50.67	46.89	50.89
Al_2O_3	20.64	18.50	19.92	18.21
Fe_2O_3	....	.15	....	....
CaO	3.78	1.05	12.11	11.27
Na_2O	7.19	9.88		
K_2O	1.74	.16		
H_2O	20.41	20.15	21.08	19.63
	100.24	100.56	100.00	100.00

The water is probably all crystalline, thus distinguishing gmelinite from a sodium chabazite; but the evidence on this point is incomplete. Pirsson's analysis may also be represented by a mixed salt of this character:



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4\equiv Na_3}\\ -\mathrm{Si_3O_8\equiv Al}\\ \diagdown\mathrm{Si_3O_8\equiv Al}\end{array}+9\mathrm{H_2O}$$

indicating a relationship to analcite. Such a relation is suggested by the experiments of Lemberg,† who not only derived analcite from the zeolites of this group, but also, starting from fused analcite, obtained a compound approximating to gmelinite in composition.

For chabazite the fundamental ratios are essentially the same as with gmelinite, but the proportions between lime and soda vary greatly. Potassium is also present to a noteworthy extent in some cases, indicating a partial derivation of the mineral from leucite, orthoclase, or microcline. As regards hydration, a part of the water in chabazite appears to be constitutional, probably two molecules out of the nine shown in the gmelinite formula, but this point is not absolutely certain. The evidence in its favor is strong, but not conclusive.

The analyses of chabazite are numerous. Some of them reduce easily to mixtures of anorthite+18 aq. and albite+9 aq., and some, showing little lime, represent isomers of gmelinite. But many chabazites are very low in alkalies, while the ratio between Si_3O_8 and SiO_4 remains practically constant. In these cases it seems necessary to assume the existence of a trisilicate anorthite, or calcium albite, which, by itself, is not known in nature. According to Doelter,‡ chabazite yields upon fusion a mixture of anorthite and silica, a fact which is in harmony with the foregoing conjecture. Taking all the data into account, chabazite may be formulated as a mixture of the compound

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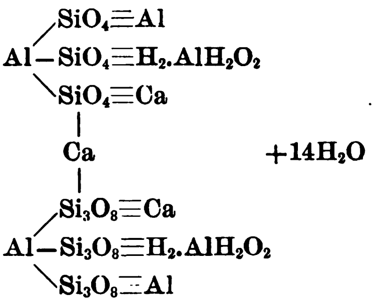
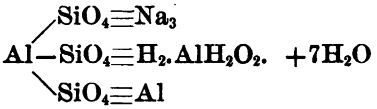
* Dana, 6th ed., p. 594.

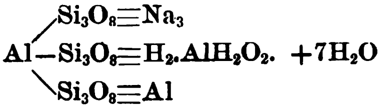
† Zeitsch. Geol. Gesell., 1885, p, 972.

‡ Allgem. Chem. Mineralogie, p. 183.



with the salts





the latter being isomeric with the gmelinite molecules. A sodium chabazite agrees in empirical composition with gmelinite, and the calcium salt by itself has the following composition, as compared with chabazite from Aussig, as analyzed by Lemberg:*

	Found.	Calculated.
SiO_2	47.50	47.43
Al_2O_3	20.00	20.15
CaO	10.20	11.07
Na_2O	.23	
K_2O	1.24	
H_2O	21.40	21.35
	100.57	100.00

It is perfectly evident that the calcium chabazite may also be written as an equimolecular mixture derived from anorthite and its trisilicate equivalent; and in levynite, the last member of the rhombohedral group, we have a mineral of the same type, although differing in hydration. Instead of 18 molecules of water, as in chabazite, levynite contains only 15; but in both cases 4 molecules are to be regarded as constitutional, in accordance with the observations made by Damour. Computing from Hillebrand's analyses,† levynite contains the ortho- and trisilicate molecules in the ratio of 3:2, giving the following empirical composition to the species:

$$3Al_6(SiO_4)_6Ca_3.\ 15H_2O + 2Al_6(Si_3O_8)_6Ca_3.\ 15H_2O,$$

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* Analysis No. 4 in Dana's table, Syst. Min., p. 591.

† Bull. U. S. Geol. Surv. No. 20, p. 38.

with the subjoined comparison between observation and theory:

	Found.	Calculated.
SiO_2	47.76	46.55
Al_2O_3	21.91	21.98
CaO	11.12	12.07
Na_2O	1.34	
K_2O	.21	
H_2O	18.65	19.40
	99.99	100.00

Here, as with the preceding minerals of this group, the accordance is quite satisfactory.

One more point with regard to chabazite remains to be noted. According to Kenngott,* a crystal of this mineral, heated to nearly the melting point of glass, retains its form and luster, but loses transparency. If, after cooling, such a dehydrated crystal be moistened with a drop of water, the latter is taken up with evolution of much heat. This observation may possibly imply that the constitutional hydroxyl of chabazite is united wholly or in part with calcium, in which case the formula as written by me should be correspondingly modified. $CaOH$ would appear in it in place of AlH_2O_2, but the fundamental type need not be thereby changed. The question thus raised suggests profitable lines for experimental investigation, which ought to shed much light upon the constitution of this and other allied minerals.

The supposition that the minerals of the chabazite group may be partly derived from a trisilicate anorthite is strongly sustained by the composition of stilbite, which, most typically, is represented by the empirical formula $Ca_3Al_6(Si_3O_8)_6 + 18H_2O$. This requires

SiO_2	57.51
Al_2O_3	16.29
CaO	8.94
H_2O	17.26
	100.00

which agrees with many analyses. Some varieties of stilbite show less silica, which may be due to the presence of orthosilicate molecules, and in most cases a little soda or potash replaces lime. The latter fact represents the presence of albite, elæolite, or orthoclase among the parent minerals of the zeolite, and involves no change in the structure of the molecule. So far as can be determined from the observations of Hersch, about two-ninths of the water in stilbite is retained at moderately high temperatures, and may therefore be regarded as constitutional. On this basis the formula of the mineral becomes

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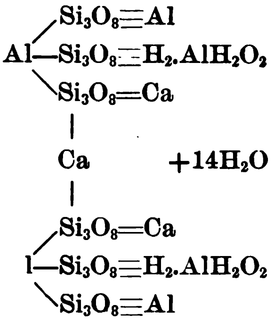
* Quoted by Hersch, p. 36.



which, in type, resembles that of chabazite, although the two species are crystallographically dissimilar.

To heulandite and epistilbite, two isomeric compounds, essentially the same formula belongs, but with less water of crystallization. Calculated with $Al_6(Si_3O_8)_6Ca_3.16H_2O$, we have for their composition

SiO_2	58.63
Al_2O_3	16.61
CaO	9.12
H_2O	15.64
	100.00

in close agreement with analysis. Hersch's work on heulandite shows about three-fourths of the water, or 12 molecules, to be easily expelled, leaving 4 molecules, as in stilbite, constitutional. Hence its structural formula may be written like that of stilbite, with 12 instead of 14 H_2O; or, $Al_4(Si_3O_8)_6Ca_3H_4(AlH_2O_2)_2.12H_2O$. Brewsterite appears to be like heulandite, but with barium and strontium replacing calcium.

According to Doelter, stilbite and heulandite, on fusion, yield a pyroxenic mineral with silica and an amorphous ground mass, and sometimes also anorthite. The same chemist* also effected the synthesis of heulandite from anorthite by digesting the latter with freshly precipitated silica and carbonated water at a temperature of 200°. These data are but partially interpreted by the constitutional formulæ here given, and for which alternative expressions are possible. A connection with anorthite is established, but the isomerism between heulandite and epistilbite, and the formation of a substance resembling pyroxene from stilbite and heulandite, remain to be accounted for. Possibly epistilbite may have the formula already given for this group, while stilbite and heulandite may contain the molecule

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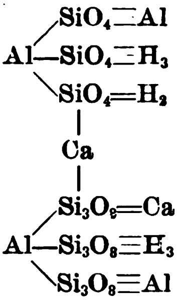
* Neues Jahrb., 1890, I, p. 128.



plus $8H_2O$ in one species and $6H_2O$ in the other. This formula was adopted in my former paper on the zeolites, and its configuration, with eight atoms of acid hydrogen, would indicate a complex breaking up upon complete dehydration. Between the two forms of expression, further investigation must decide. Both are in harmony with the fundamental theory, so that the questions at issue are mainly questions of detail.

To stilbite, morphologically, the species harmotome and phillipsite are closely allied. To harmotome may be assigned the formula $Al_6(SiO_4)_2(Si_3O_8)_4Ba_3.14H_2O$, which requires

SiO_2	45.23
Al_2O_3	16.48
BaO	24.72
H_2O	13.57
	100.00

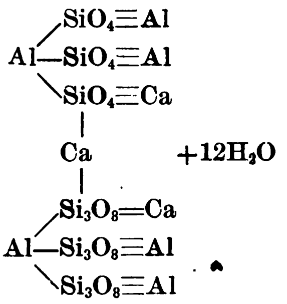
A little barium is commonly replaced by potassium or sodium, perhaps, or even probably as $Al_3(Si_3O_8)_3K_3.7H_2O$, the water being loosely combined and therefore all crystalline. In all probability harmotome is a derivative by hydration of the barium feldspar, hyalophane.

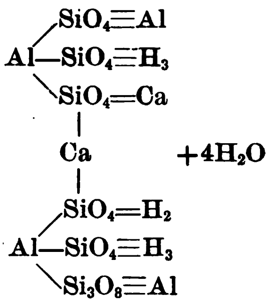
In phillipsite, which, since the investigations of Fresenius, has been generally recognized as the calcium equivalent of harmotome, we find a larger proportion of the bivalent metal replaced by potassium or sodium, and a more variable ratio between SiO_4 and Si_3O_8. A typical phillipsite approaches nearly to the formula $Al_6(SiO_4)_3(Si_3O_8)_3Ca_2K_2.14H_2O$, which requires

SiO_2	48.52
Al_2O_3	20.63
CaO	7.54
K_2O	6.33
H_2O	16.98
	100.00

Here again no water is constitutional. In my former paper I assigned to both phillipsite and harmotome a hydration of 15 molecules, but 14 agrees better with the published analyses. In some cases the calcium of phillipsite is lower and the alkaline metals higher than is shown by the ratio Ca_2K_2, but the ratio CaR'_4 does not appear to be reached, unless by the presence of H among the components of R'_4 The general formula for phillipsite and harmotome, as shown by all trustworthy analyses, is $Al_6X_6R''_3.14H_2O$, when X represents $SiO_4+Si_3O_8$ and R'' is made to include the equivalent of the alkalies. Fusion experiments upon the two species seem to be wanting.

To laumontite, $CaAl_2Si_4O_{12}.4H_2O$, two constitutional formulæ may be assigned. as follows:



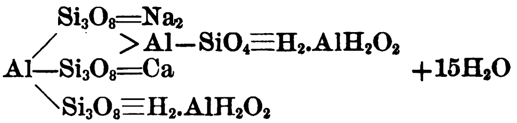


Both expressions give the same empirical composition, but the first is the more symmetrical. The second indicates a ratio between constitutional and crystalline water which agrees with the somewhat incomplete recorded data, but the first is adjustable in such a manner as to represent the same facts. According to Doelter,* laumontite upon fusion gives anorthite, together with a pyroxenic mineral and an amorphous ground mass, and this evidence may harmonize with either formula. A fuller experimental investigation of this species is evidently necessary.

For the isometric faujasite the formula may be written structurally in two ways. One is in uniformity with the expressions assigned to the previous species, and is

$$Al_4(SiO_4)_4(Si_3O_8)_2Na_2CaH_8.15H_2O$$

The other is based upon the analcite formula, as developed in the preceding chapter, thus:



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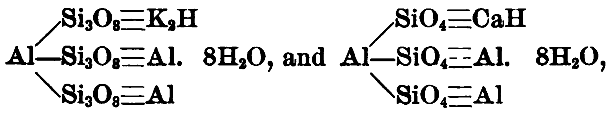
* Neues Jahrb., 1890, I, p. 130.

From these, which are empirically identical, we get the subjoined comparison between theory and the analysis by Damour:[*]

	Found.	Calculated.
SiO_2	46.12	47.46
Al_2O_3	16.81	16.14
CaO	4.79	4.43
Na_2O	5.09	4.91
H_2O	27.02	27.06
	99.83	100.00
$15H_2O=$	....	21.36

According to Jannasch,[†] faujasite loses 10.88 per cent of water at 105°–110°. At 150° it loses 16.83, about 12 molecules, which is regained in moist air. Between 250° and 260° it loses 22.67 per cent, and the remainder of the water is expelled upon ignition. Of the two formulæ given, the one corresponding to the leucite-analcite type is preferable, for it represents the morphological analogy between the species. Furthermore, faujasite on treatment with hydrochloric acid is decomposed, but does not gelatinize, a fact which may indicate a predominance of trisilicate over orthosilicate groups. This datum, however, is of questionable significance.

One more zeolite, the little-known species offretite, remains to be considered in this connection. This may be represented as a mixture of two molecules,



$$Al\begin{cases} Si_3O_8\equiv K_2H \\ Si_3O_8\equiv Al. \; 8H_2O, \\ Si_3O_8\equiv Al \end{cases} \text{and} \quad Al\begin{cases} SiO_4\equiv CaH \\ SiO_4\equiv Al. \; 8H_2O, \\ SiO_4\equiv Al \end{cases}$$

in the ratio of 2:1. This gives, in comparison with Gonnard's analysis, the following composition:

	Found.[‡]	Calculated.
SiO_2	52.47	52.02
Al_2O_3	19.06	18.95
CaO	2.43	2.30
K_2O	7.72	7.77
H_2O	18.90	18.96
	100.58	100.00

This species is evidently a derivative of orthoclase and anorthite, and the calcium term in the foregoing formula may evidently be written on the anorthite type, namely, as $Al_6(SiO_4)_6Ca_2H_2.16H_2O$. The character of its hydration, other than is shown in the formula as given, remains to be determined. The mineral is decomposable by acids with difficulty.

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[*] Dana's System, 6th ed., p. 598.

[†] Neues Jahrb., 1887, II, p. 24.

[‡] Dana's System, 6th ed., p. 1043.

From the evidence given in the foregoing pages the constitutional and genetic connection between the normal zeolites and the feldspars seems to be perfectly clear, and it ought to be easily emphasized by investigations along petrographic lines. Data of this kind, in addition to those already cited, are even now available, and many alterations of the most pertinent kind have been observed. Thus laumontite, heulandite, stilbite, and analcite alter into albite or orthoclase; laumontite and stilbite into analcite; chabazite into natrolite; and gismondite into phillipsite. So also alterations into prehnite are recorded on the part of laumontite, scolecite, mesolite, natrolite, and analcite; and the identity of chemical type seems to be almost unquestionable. From the formulæ here developed all of these alterations become intelligible, and the theory of substitution from normal salts is very emphatically sustained. For the group of zeolites it only remains to summarize the expressions which have been adopted.

For starting points the following minerals are taken:

Nephelite	$Al_3(SiO_4)_3Na_3$
Albite and orthoclase	$Al_3(Si_3O_8)_3R'_3$
Anorthite	$Al_6(SiO_4)_6Ca_3$
Trisilicic anorthite	$Al_6(Si_3O_8)_6Ca_3$

The last compound is purely hypothetical. To these may be added leucite, from which analcite and faujasite are derivable, and the barium-strontium feldspars which give rise to brewsterite, edingtonite, and harmotome. Brewsterite, as the equivalent of heulandite, and harmotome, as a barium phillipsite, need not be considered further; and as for edingtonite, its constitution is very uncertain. The remaining zeolites are as follows, with the difference between water of constitution and water of crystallization disregarded, except in the few cases in which the distinction affects the integrity of the molecular type. The symbol X is used to express SiO_4 or Si_3O_8 indiscriminately:

Type $Al_3X_3R'_3$.

Hydronephelite	$Al_3(SiO_4)_3Na_2H, 3H_2O$
Offretite	$Al_3(SiO_4)(Si_3O_8)_2R'_3, 8H_2O$
Gmelinite	$Al_3(SiO_4)(Si_3O_8)_2Na_3, 9H_2O$

Type $Al_6X_6Ca_3$.

Thomsonite	$Al_6(SiO_4)_6Ca_3, 7H_2O$
Gismondite	$Al_6(SiO_4)_6Ca_3, 12H_2O$
Laumontite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_3, 12H_2O$
Phillipsite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_2K_2, 14H_2O$
Levynite	$Al_6X_6Ca_3, 15H_2O$
Heulandite, epistilbite	$Al_6(Si_3O_8)_6Ca_3, 16H_2O$
Stilbite	$Al_6(Si_3O_8)_6Ca_3, 18H_2O$
Chabazite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_3, 18H_2O$

Type $Al_2X_3R'_6$.

Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Scolecite	$Al_2(SiO_4)_3CaH_4, H_2O$

Type $Al_4X_6Ca_6$.

Mesolite	$Al_4(SiO_4)_6CaNa_2H_8, H_2O$
Foresite	$Al_4(SiO_4)_6CaH_{10}, H_2O$

Some of these formulæ are conditioned by the replacements and alternatives cited in the previous pages and in my former paper upon the zeolites, and they are further modified by the character of the hydration. The expressions for analcite and faujasite, as based upon the leucite type, need not be repeated.

The morphological characteristics of the zeolites probably depend in great part upon their mode of hydration, but this point needs to be developed. So also does the relation between zeolites and kaolin, into which the minerals of this group sometimes alter. Furthermore, zeolitic substances of indeterminate nature are believed to exist in soils and clays, and it is conceivable that such bodies may be intermediately formed during the transition from feldspar into kaolin. In studying the mechanism of that change this possibility ought to be considered.

V. THE MICAS AND CHLORITES.

On account of their wide distribution, their variety of composition, and their genetic relations to other species, the micas and chlorites form one of the most instructive and interesting families of minerals. Two of the micas, muscovite and biotite, have already been noted among the members of the first and second of the preceding groups; and we have seen how frequently they arise from the alteration of other silicates, while these in some cases have been synthetically derived from micaceous material.

As regards the substitution theory, the minerals of this family are peculiarly suggestive, for the reason that they form a series of the most complete character. Thus, starting from the normal aluminum orthosilicate, we have

Normal orthosilicate	$Al_4(SiO_4)_3$
Muscovite	$Al_3(SiO_4)_3KH_2$
Normal biotite	$Al_2(SiO_4)_3Mg_2KH$
Normal phlogopite	$Al(SiO_4)_3Mg_3KH_2$

No further substitution of the same order is possible, for the reason that its formation would remove the linking atom of aluminum, and break up the fundamental molecule.

Muscovite, the first species in the foregoing series, occurs in nature as an independent mineral, and also as an alteration product of nephelite, eucryptite, topaz, andalusite, the feldspars, the scapolites, and various other natural silicates. All of these alterations become intelligible in the light of the formulæ adopted in this memoir. In its more typical occurrences muscovite agrees sharply with the formula given, but it varies in composition within well-defined limits. First, it ranges toward its sodium equivalent, paragonite, which has the corresponding formula $Al_3(SiO_4)_3NaH_2$. Secondly, in fuchsite, the chromic mica, a chromium salt partly replaces the aluminum compound, and similar ferric replacements are also known. In all of these variations, however, there is no change of ratios, and the typical formula remains undisturbed. In the barium mica, œllacherite, there is possibly a molecule of the type $Al_3(SiO_4)_3R''R'$, but this is uncertain. Other interpretations of the barium micas are admissible.

The most important variation in muscovite is in the direction of increased silica. Normal muscovite contains 45.3 per cent of SiO_2, but varieties exist in which the percentage rises to nearly 59. Muscovites of this class have been designated by Tschermak as phengites, and they are most easily explained upon the supposition of trisilicate admixtures. The molecule $Al_3(Si_3O_8)_3KH_2$ is identical in type with ordinary orthosilicate muscovite, and its presence completely accounts for all excesses of silica over the normal amount. In Sandberger's lepidomorphite, for instance, the orthosilicate and trisilicate molecules occur in nearly equal proportions. All known muscovite may be represented by the general formula $Al_3(SiO_4)_3R'_3+Al_3(Si_3O_8)_3R'_3$, in which the latter molecule varies from zero to fifty per cent, and with ferric iron or chromium sometimes replacing aluminum.

With the biotites and phlogopites the variability of composition is even greater than in the case of muscovite. For the typical molecules the composition would be

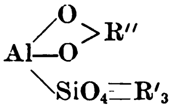
	$Al_2(SiO_4)_3Mg_2KH$.	$Al(SiO_4)_3Mg_3KH_2$.
SiO_2	43.06	43.27
Al_2O_3	24.40	12.26
MgO...........	19.14	28.85
K_2O	11.25	11.29
H_2O	2.15	4.33
	100.00	100.00

To these types but few natural micas actually correspond, although intermediate mixtures are very common. Furthermore, ferrous salts frequently replace the magnesium compounds, and ferric molecules replace those of aluminum. Manganese, also, sometimes occurs among the dyad bases, and occasionally trisilicates in small amount are commingled with the ortho-salts. Because of these complications, the reduction of a given analysis to a specific formula may be very difficult, and this difficulty is often increased by uncertainty in the determination of water, or of the state of oxidation of the iron. In spite of these difficulties, however, the reduction is generally possible, and the ferromagnesian micas, with some exceptions to be noted further on, are representable as mixtures of the two types shown in the formulæ as given. The iron mica siderophyllite agrees closely in composition with a normal ferrous biotite, $Al_2(SiO_4)_3Fe_2KH$. Aspidolite appears to be a sodium phlogopite, but needs reanalysis. In exceptional cases, muscovitic types seem to exist among these micas, and certain lepidomelanes approximate to the general formula $Al_3(SiO_4)_3Fe''K+Fe'''_3(SiO_4)_3Fe''K$. Another unusual mica is Breithaupt's alurgite, which, as analyzed by Penfield,* corresponds to a mixture of molecules

2. $Al_3(Si_3O_8)_3KH_2$
3. $Al_2(SiO_4)_3K_2H_4$
3. $Al_2(SiO_4)_3Mg_2KH$,

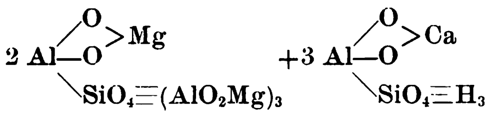
with a slight excess of H over K in the last compound. The second of these molecules, an alkaline biotite, is the characteristic feature of alurgite. Similar compounds, parallel to phlogopite, seem also to exist, having the general formula $Al(SiO_4)_3R'_9$; but all of these bodies conform sharply to the general theory of the micas, and are substitution derivatives of the normal aluminum salt.

In many of the magnesian micas fluorine is found, and the iron micas frequently contain oxygen in excess of the amount necessary to convert all of the silicon into the radicle SiO_4. When this excess is real, that is, not ascribable to defective analysis, it may be due either to alteration or to admixtures of micas belonging to the clintonite group. This group, the members of which resemble biotite morphologically, are extremely basic, and are representable by the general formula



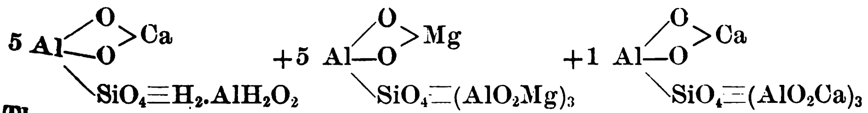
$$\mathrm{Al}\begin{array}{l}\left<{}^{\mathrm{O}}_{\mathrm{O}}\right>\mathrm{R}''\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{R}'_3\end{array}$$

in which R'_3 may be replaced by Al, or by $R''R'$, R'' being magnesium, calcium, or ferrous iron. The univalent group AlO_2R'' may also appear in R', giving as the extreme end of the clintonite series the compound $(AlO_2R'')_4SiO_4$. In seybertite and brandisite we have nearly



$$2\,\mathrm{Al}\begin{array}{l}\left<{}^{\mathrm{O}}_{\mathrm{O}}\right>\mathrm{Mg}\\ \diagdown\mathrm{SiO_4}\equiv(\mathrm{AlO_2Mg})_3\end{array}+3\,\mathrm{Al}\begin{array}{l}\left<{}^{\mathrm{O}}_{\mathrm{O}}\right>\mathrm{Ca}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H_3}\end{array}$$

while xanthophyllite† is



$$5\,\mathrm{Al}\begin{array}{l}\left<{}^{\mathrm{O}}_{\mathrm{O}}\right>\mathrm{Ca}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H_2.AlH_2O_2}\end{array}+5\,\mathrm{Al}\begin{array}{l}\left<{}^{\mathrm{O}}_{\mathrm{O}}\right>\mathrm{Mg}\\ \diagdown\mathrm{SiO_4}\equiv(\mathrm{AlO_2Mg})_3\end{array}+1\,\mathrm{Al}\begin{array}{l}\left<{}^{\mathrm{O}}_{\mathrm{O}}\right>\mathrm{Ca}\\ \diagdown\mathrm{SiO_4}\equiv(\mathrm{AlO_2Ca})_3\end{array}$$

The xanthophyllite, upon ignition, decomposes into a portion soluble and a portion insoluble in hydrochloric acid. The insoluble portion has the composition of spinel, a mineral which is generally found accompanying clintonite micas, and of which the formation is rendered intelligible by the formulæ. Whether chloritoid belongs here or not is doubtful, but if it does its formula may be written

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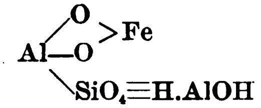
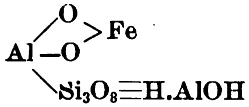
*Am. Jour. Sci., (3) XLVI, p. 289. 1893.

†See Clarke and Schneider, U. S. G. S. Bulletin No. 113, p. 27.



Ottrelite may possibly be essentially the trisilicate equivalent of chloritoid,

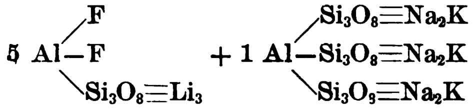


and Damour's venasquite approaches this composition. Variations in composition in ottrelite correspond to mixtures of this molecule with small quantities of chloritoid. Venasquite, however, is also reducible to the normal mica type, and agrees sharply with

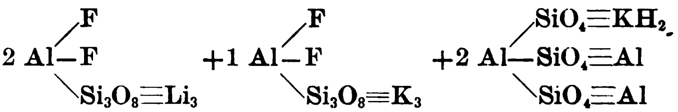
$$\begin{gathered}2\ Al_3(SiO_4)_3H_3 + \\ 3\ Al_2(SiO_4)_3Fe_2H_2\end{gathered}$$

It may be that ottrelite and its varieties represent the first stage intermediate between micas and vermiculites; the alkalies of mica having been replaced by water, all R′ becoming H.

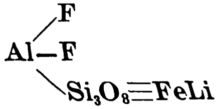
Although fluorine is found in micas of all classes, it is chiefly characteristic of lepidolite, zinnwaldite, and phlogopite, and is generally connected with a low oxygen ratio. Indeed, the extreme end of the lepidolite series, polylithionite, is entirely trisilicate in character, and its existence fully justifies the assumption that trisilicates occur in other micas. Furthermore, polylithionite furnishes a clew to the entire lepidolite or lithia mica series, and its formula is easily written



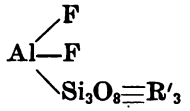
the dominant molecule being akin to clintonite in general constitution. Ordinary lepidolite contains the same molecule, mingled with molecules of the muscovite type, and an average example is represented by



In cryophyllite we have similar molecules, plus molecules of an iron biotite, $Al_2(SiO_4)_3Fe_2H_2$. Cryophyllite is associated most intimately with an iron mica of that general character, and lepidolite, similarly, is always accompanied by muscovite. In zinnwaldite the molecule

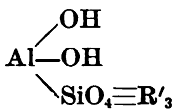


robably occurs, commingled with others of the ordinary lepidolite and muscovite types. In short, all the lithia micas contain compounds of the type



with members of the normal mica series.* The fluoriferous phlogopites may contain molecules of the same character, especially $AlF_2.Si_3O_8.MgK$, or they may be of the normal type with univalent $-Mg-F$ among the monad bases. Between these alternatives it is difficult to decide, and more evidence is necessary.

By alteration lepidolite passes into cookeite, a mineral which well illustrates the equivalent character of hydroxyl and fluorine. Penfield's analysis gives for cookeite a general formula,



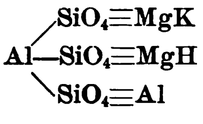
and in detail a mixture of molecules,

$$
\begin{aligned}
&10Al(OH)_2SiO_4.Li_3\\
+&14Al(OH)_2SiO_4.H_3\\
+&33Al(OH)_2SiO_4.Al
\end{aligned}
$$

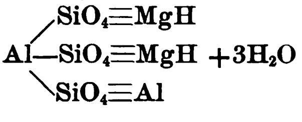
The identity of type between cookeite and lepidolite is perfectly clear, and the analogy with the clintonite micas is still more apparent.

In a similar way the other micas alter by hydration, yielding a great variety of products which are known in general as vermiculites. This is especially true as regards the ferromagnesian micas, which lose alkalies and take up water with the greatest ease, in accordance with what seems to be a well-defined law. Thus we have

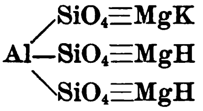
Biotite.



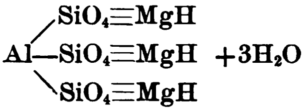
Hydrobiotite.



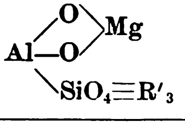
Phlogopite.



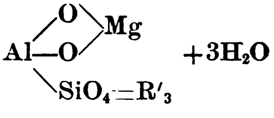
Hydrophlogopite.



Clintonite.



Hydroclintonite.



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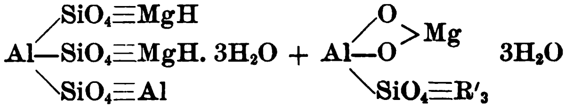
* For fuller discussion, see Bulletin U. S. G. S. No. 113, p. 22.

The micas in question occur in nature in great variety of admixture, and the corresponding vermiculites show a parallel complexity. In every case, however, the alteration of the one series into the other follows the line indicated by the formulæ, and the vermiculite is simply the mica with H in place of K or Na, plus 3 molecules of loosely combined water. Two of these molecules are, as a rule, given off at 100°, and regained in moist air, suggesting an analogy between the vermiculites and the zeolites. Some vermiculites, however, are only monohydrated, and many of the so-called species which have received names are mere mixtures of altered and unaltered micas, representing stages of transition between the original mineral and the final product. Among the more characteristic vermiculites, kerrite, protovermiculite, hallite, and lennilite appear to be essentially trihydrated mixtures of the hydrophlogopite and hydroclintonite types, commingled in ratios nearly as follows:

	Hydrophlog.		*Hydroclint.*
Kerrite	5	:	1
Protovermiculite	1	:	1
Hallite	7	:	18

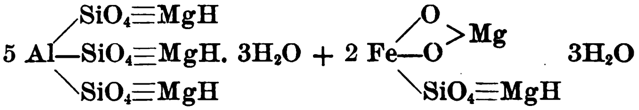
Lennilite is near hallite, and both may contain small admixtures of chloritic material. The kerrite is quite near the typical hydrophlogopite alone.

Jefferisite resembles protovermiculite in ratios, but with a hydrobiotite in place of the hydrophlogopite; that is,



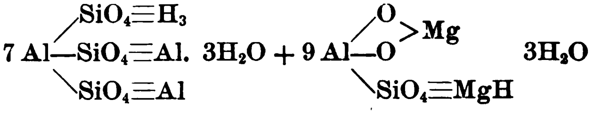
$$\mathrm{Al}\left\{\begin{array}{l}\mathrm{SiO_4{\equiv}MgH}\\ \mathrm{SiO_4{\equiv}MgH}\\ \mathrm{SiO_4{\equiv}Al}\end{array}\right.\mathrm{.\ 3H_2O} + \mathrm{Al}\left\{\begin{array}{l}\left.\begin{array}{l}\mathrm{O}\\ \mathrm{O}\end{array}\right>\mathrm{Mg}\\ \mathrm{SiO_4{\equiv}R'_3}\end{array}\right.\quad \mathrm{3H_2O}$$

and vaalite is very nearly



$$5\,\mathrm{Al}\left\{\begin{array}{l}\mathrm{SiO_4{\equiv}MgH}\\ \mathrm{SiO_4{\equiv}MgH}\\ \mathrm{SiO_4{\equiv}MgH}\end{array}\right.\mathrm{.\ 3H_2O} + 2\,\mathrm{Fe}\left\{\begin{array}{l}\left.\begin{array}{l}\mathrm{O}\\ \mathrm{O}\end{array}\right>\mathrm{Mg}\\ \mathrm{SiO_4{\equiv}MgH}\end{array}\right.\quad \mathrm{3H_2O}$$

Maconite and lucasite are probably micas which have been partly vermiculitized, and an essential portion of the first-named mineral appears to be a derivative of muscovite. Roseite is very near a mixture of partially muscovitic character, viz:

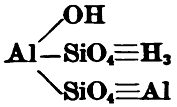


$$7\,\mathrm{Al}\left\{\begin{array}{l}\mathrm{SiO_4{\equiv}H_3}\\ \mathrm{SiO_4{\equiv}Al}\\ \mathrm{SiO_4{\equiv}Al}\end{array}\right.\mathrm{.\ 3H_2O} + 9\,\mathrm{Al}\left\{\begin{array}{l}\left.\begin{array}{l}\mathrm{O}\\ \mathrm{O}\end{array}\right>\mathrm{Mg}\\ \mathrm{SiO_4{\equiv}MgH}\end{array}\right.\quad \mathrm{3H_2O}$$

Each of these expressions gives the composition of its respective mineral very closely, and so strengthens the general mica theory. The character of the alteration from a mica is simple, and is what is most reasonably to be expected.

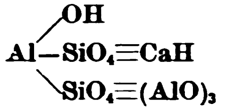
From some points of view, and especially with reference to its crystalline form, kaolin may be regarded as a member of the mica group. As such it would form a connecting link between the micas proper and the clintonite group, and with it the calcium mica, margarite, can be correlated. Furthermore, margarite yields an alteration product, dudleyite, which falls into line with the other two species, thus:

Kaolin.



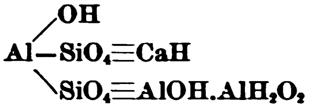
$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ -\mathrm{SiO_4{\equiv}H_3}\\ \mathrm{SiO_4{\equiv}Al}\end{cases}$$

Margarite.



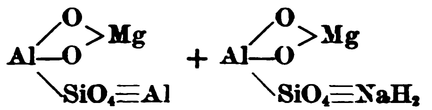
$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ -\mathrm{SiO_4{\equiv}CaH}\\ \mathrm{SiO_4{\equiv}(AlO)_3}\end{cases}$$

Dudleyite.



$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ -\mathrm{SiO_4{\equiv}CaH}\\ \mathrm{SiO_4{\equiv}AlOH.AlH_2O_2}\end{cases}$$

These expressions are suggestive, but not altogether conclusive. They represent the known facts fairly well, however, and can serve their purpose for the time being. Several other micaceous minerals are altogether doubtful in character, and need only passing mention. Thus helvetan may be a trisilicate of the biotite type. Caswellite,* an alteration product of a manganesian biotite, may be written as a member of the clintonite group. Willcoxite seems to be an alkaline clintonite, and corresponds very closely to



$$\mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}>\mathrm{Mg}\\ \mathrm{SiO_4{\equiv}Al}\end{cases} + \mathrm{Al}\begin{cases}\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}>\mathrm{Mg}\\ \mathrm{SiO_4{\equiv}NaH_2}\end{cases}$$

There are also several vermiculitic minerals which probably belong in the chlorite group. All of these supposed species need further investigation.

In roscoelite, which is a vanadium mica, the ratios are quite uncertain. According to Genth, the mineral contains V_2O_3, while Roscoe gives the vanadium as V_2O_5; and in other respects the analyses are discordant. If Genth's analysis is accepted, roscoelite has essentially the ratios of a phengitic muscovite, with half of the aluminum replaced by vanadium. This seems to be probable, but the species needs reanalysis.

Ganophyllite, described by Hamberg in 1890,† and regarded by the discoverer as a manganese zeolite, should probably be classed with the micas. Like the micas, it is monoclinic, highly cleaveable, and gives a percussion figure consisting of a six-rayed star. In all its physical characteristics it resembles the micas, with one of which, manganophyll, it is associated. It loses water, however, in vacuo, regaining the amount lost on exposure to moist air, and on this account it may be compared either with the zeolites or with the vermiculite group.

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*Chester, Trans. N. Y. Acad. Sci., XIII, p. 97, 1894.

†Geol. Fören. Förhandl., XII, p. 586.

On the latter basis it agrees in composition with a hydrated manganese phlogopite, having the subjoined admixture of molecules:

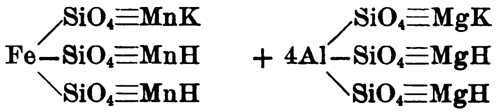
1. $Al(Si_3O_8)_3Mn_3H_3.2aq.$
1. $Al(SiO_4)_3Mn_3H_3.2aq.$
2. $Al(SiO_4)_3Mn_3KH_2.2aq.$
3. $Al(SiO_4)_3Mn_3NaH_2.2aq.$

or, in percentages, as follows:

	Found.	Calculated.
SiO_2	39.67	39.99
Al_2O_3	7.95	8.81
Fe_2O_3	.90	
MnO	35.15	36.80
CaO	1.11	
MgO	.20	
PbO	.20	
K_2O	2.70	2.33
Na_2O	2.18	2.29
H_2O	9.79	9.78
	99.85	100.00

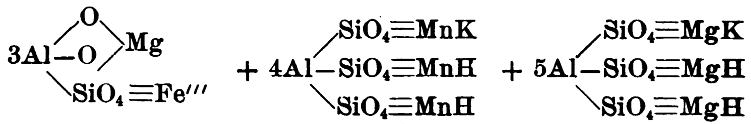
Of this water 6.22 per cent is crystalline and 3.56 constitutional.

The associated manganophyll has also phlogopite ratios, but varies so widely in composition as to show that it is, like many other micas, a mixture. Hamberg gives two analyses of this mineral; the first variety, of a reddish-brown color, agrees with



$$\mathrm{Fe}\begin{cases}\mathrm{SiO_4\equiv MnK}\\ \mathrm{SiO_4\equiv MnH}\\ \mathrm{SiO_4\equiv MnH}\end{cases} + 4\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv MgK}\\ \mathrm{SiO_4\equiv MgH}\\ \mathrm{SiO_4\equiv MgH}\end{cases}$$

The second variety, which is dark-brown, may be written



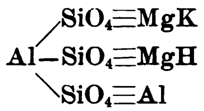
$$3\mathrm{Al}\begin{cases}\left.\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}\right\rangle\mathrm{Mg}\\ \mathrm{SiO_4\equiv Fe'''}\end{cases} + 4\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv MnK}\\ \mathrm{SiO_4\equiv MnH}\\ \mathrm{SiO_4\equiv MnH}\end{cases} + 5\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv MgK}\\ \mathrm{SiO_4\equiv MgH}\\ \mathrm{SiO_4\equiv MgH}\end{cases}$$

These manganophylls are from Pajsberg, but the manganophyll from Longban, analyzed by Flink, has ratios which indicate the presence of biotitic molecules somewhat similar to those found in alurgite. Manganophyll, however, contains among its constituents a true manganese phlogopite, of which ganophyllite is most probably the hydrate. On this basis both minerals are most easily explained, and all their relations are accounted for.

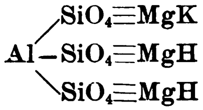
Between the micas and the chlorites the relations are exceedingly close, as regards both composition and physical properties, and from *certain points* of view the vermiculites are to be regarded as a *transitional series* connecting the two groups. All the species are highly foliated, all or nearly all are monoclinic, *and to each of the definite* ferromagnesian micas a chlorite, higher in magnesia and water, seems to correspond. In former publications* I have sought to show that the chlorites may be interpreted as derived from magnesium orthosilicate in the same way that the micas are derived from the normal aluminum salt; but fuller consideration leads me to a more satisfactory generalization, which unites both series under one set of fundamental formulæ.

Returning to the normal micas and ignoring the replacements of magnesium and aluminum by other equivalent bases, we have the following formulæ already developed:

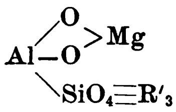
Biotite.



Phlogopite.

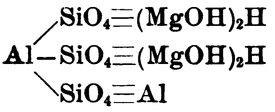


Clintonite.

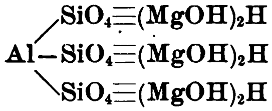


By admixtures of these types all of the ferromagnesian micas are completely explained, and for the orthochlorite series the following parallel expressions are similarly sufficient:

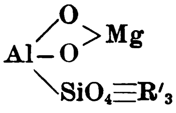
Biotite-chlorite.



Phlogopite-chlorite.



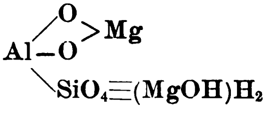
Chloritoid type.



An average pennine consists of the first and second of these types in the ratio 1:1, and an average clinochlore has the same molecules in the ratio 2:1. From these ratios the following composition is deduced:

	Pennine.	Clinochlore.
SiO_2	34.35	34.97
Al_2O_3	14.60	16.51
MgO	38.17	36.27
H_2O	12.88	12.25
	100.00	100.00

In both minerals, as among the corresponding micas, admixtures of molecules of the third type occur, giving a range of variation which is shown in the published analyses. Thus, for leuchtenbergite, we have, with the molecules given above, a large admixture of the compound



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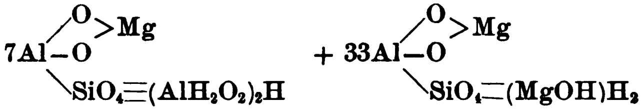
* Bull. U. S. Geol. Survey, No. 78, p. 22; Bull. No. 90, p. 17; Bull. No. 113, pp. 11 and 27.

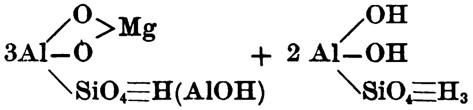
while in prochlorite and corundophilite the latter compound predominates. Prochlorite has the last formula, with trifling admixtures of chloritoid or ottrelite, and corundophilite agrees with the composition



$$7\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{Mg}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv(\mathrm{AlH_2O_2})_2\mathrm{H}\end{array} + 33\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{Mg}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\end{array}$$

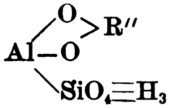
In both prochlorite and corundophilite there are large replacements of magnesium by iron.

To these formulæ some of the rarer or obscurer chlorites offer interesting variations, which, however, are all simple and intelligible. Thus, rumpfite is represented by the formula



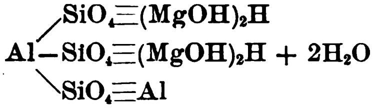
$$3\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{Mg}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H}(\mathrm{AlOH})\end{array} + 2\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{OH}\\ -\mathrm{OH}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H_3}\end{array}$$

the first compound being a magnesian chloritoid, and the second a molecule already indicated in cookeite. The original delessite is very near



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{O}>\mathrm{R''}\\ -\mathrm{O}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{H_3}\end{array}$$

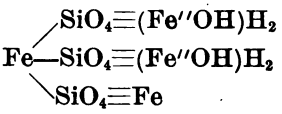
while the Scotch delessites, analyzed by Heddle, agree sharply with the formula



$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\ -\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array} + 2\mathrm{H_2O}$$

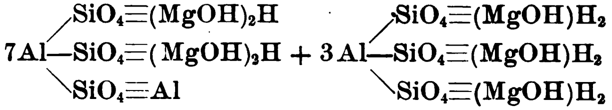
with one-fourth of the Mg replaced by Fe. In the last case the discrimination between hydroxyl and water of crystallization is shown by the analyses, and it is very probable that an analytical revision of the chlorites would bring other instances of the same kind to light.

For melanolite we have very closely the composition



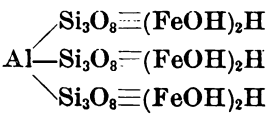
$$\mathrm{Fe}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{Fe''OH})\mathrm{H_2}\\ -\mathrm{SiO_4}\equiv(\mathrm{Fe''OH})\mathrm{H_2}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{Fe}\end{array}$$

and for euralite



$$7\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\ -\mathrm{SiO_4}\equiv(\mathrm{MgOH})_2\mathrm{H}\\ \diagdown\mathrm{SiO_4}\equiv\mathrm{Al}\end{array} + 3\,\mathrm{Al}\begin{array}{l}\diagup\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\\ -\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\\ \diagdown\mathrm{SiO_4}\equiv(\mathrm{MgOH})\mathrm{H_2}\end{array}$$

Trisilicate molecules, as among the micas, also appear in the chlorite series, and stilpnomelane is a good example of this kind. Its formula is very nearly

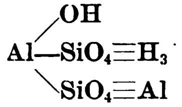


$$\mathrm{Al}\begin{array}{l}\diagup\mathrm{Si_3O_8}\equiv(\mathrm{FeOH})_2\mathrm{H}\\ -\mathrm{Si_3O_8}\equiv(\mathrm{FeOH})_2\mathrm{H}\\ \diagdown\mathrm{Si_3O_8}\equiv(\mathrm{FeOH})_2\mathrm{H}\end{array}$$

with very little SiO_4, and epichlorite is a *mixture of this salt with the* equivalent $Al(SiO_4)_3(MgOH)_6H_3$, the two compounds being commingled in nearly equal percentages, or about half and half.

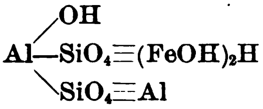
Some of the chlorites, also, are parallel with kaolin and margarite in constitution. Aphrosiderite and strigovite, for example, are well represented, as follows:

Kaolin.



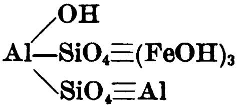
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{OH}\\ -\mathrm{SiO_4{\equiv}H_3}\\ \diagdown \mathrm{SiO_4{\equiv}Al}\end{array}$$

Strigovite.



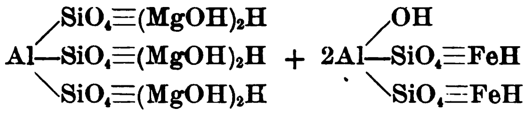
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{OH}\\ -\mathrm{SiO_4{\equiv}(FeOH)_2H}\\ \diagdown \mathrm{SiO_4{\equiv}Al}\end{array}$$

Aphrosiderite.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{OH}\\ -\mathrm{SiO_4{\equiv}(FeOH)_3}\\ \diagdown \mathrm{SiO_4{\equiv}Al}\end{array}$$

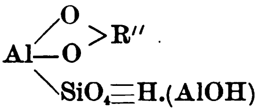
with much ferric iron in strigovite in place of aluminum. In diabantite we find a composition indicative of a mixture between a molecule of this type and one in the normal series. The diabantite from Connecticut, for instance, is very near



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{SiO_4{\equiv}(MgOH)_2H}\\ -\mathrm{SiO_4{\equiv}(MgOH)_2H}\\ \diagdown \mathrm{SiO_4{\equiv}(MgOH)_2H}\end{array} + 2\mathrm{Al}\begin{array}{l}\diagup \mathrm{OH}\\ -\mathrm{SiO_4{\equiv}FeH}\\ \diagdown \mathrm{SiO_4{\equiv}FeH}\end{array}$$

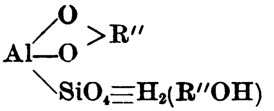
For the minerals daphnite, metachlorite, klementite, chamoisite, thuringite, and cronstedtite, the formulæ are more or less doubtful, for the reason that alternatives are possible. They all, however, reduce to mixtures of the chloritoid or clintonite type, of the forms

A.



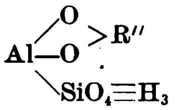
$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{O}\\ -\mathrm{O}\\ \diagdown \mathrm{SiO_4{\equiv}H.(AlOH)}\end{array}\!\!>\mathrm{R''}$$

B.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{O}\\ -\mathrm{O}\\ \diagdown \mathrm{SiO_4{\equiv}H_2(R''OH)}\end{array}\!\!>\mathrm{R''}$$

C.



$$\mathrm{Al}\begin{array}{l}\diagup \mathrm{O}\\ -\mathrm{O}\\ \diagdown \mathrm{SiO_4{\equiv}H_3}\end{array}\!\!>\mathrm{R''}$$

Using the letters underneath the formulæ as symbols, the several species become

Chamoisite	B_1C_1,	with all $R''=Fe$
Metachlorite	B_3C_1,	with all $R''=Fe$
Thuringite	$A_1B_1C_1$,	with all $R''=Fe$
Klementite	$A_1B_2C_1$,	with R'' mostly Mg
Daphnite	$A_1B_5C_4$,	with R'' mostly Fe

In cronstedtite there is a range from $A_1B_1C_1$, as in thuringite, to A_1B_2, and all the aluminum is replaced by ferric iron, while all $R''=Fe$. These expressions give the composition of the several species very closely, and serve to correlate them with delessite, rumpfite, prochlorite. and corundophilite. All of the valid evidence is satisfied, and the micas, clintonites, vermiculites, and chlorites form one systematic group. The facts that garnet and vesuvianite alter into chlorites, and that chloritic pseudomorphs after feldspar are known, serve to still more closely connect the formulæ here adopted with the similar formulæ of the preceding groups of minerals.

When clinochlore or leuchtenbergite is strongly ignited, it yields, like xanthophyllite, a product insoluble in hydrochloric acid, having the composition of spinel. This reaction establishes still more definitely the relationship between the chlorites and the clintonite group, and it is readily intelligible in the light of the structural expressions. The splitting up, under influence of heat, of mixtures containing such groups of atoms as MgOH, AlOH, and AlO_2H_2, ought to generate spinel, and the appearance of a compound of this character is evidence in favor of the formulæ.

VI. THE TOURMALINE GROUP.

Although tourmaline, in its several varieties, is apparently quite complex, the evidence for its interpretation is abundant and ample. Its variations in composition are shown by numerous good analyses, its associations are well known, and its alteration products have been observed in a sufficient number of cases. From the minerals which have been discussed in the preceding chapters, it differs essentially in that it contains boron, and the part played by this element is a new question to be interpreted.

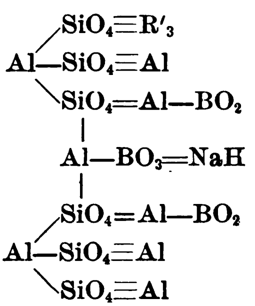
When tourmaline undergoes alteration, the commonest product is a mica, and between the micas and the tourmalines there are very striking analogies. With the lithia micas, lithia tourmalines are generally associated; with muscovite and biotite, iron tourmalines occur, and magnesian tourmalines accompany phlogopite. In each case the composition of the tourmaline seems to bear a relation to that of the associated mica. Furthermore, the varieties of tourmaline shade one into another through an unbroken series of gradations, and this may happen to some extent in one and the same crystal. The genus tourmaline, in short, represents a series of compounds, and these are parallel to the normal mica series. These considerations lead directly to a system of formulæ, which, like those of the micas, are derivable from molecules of the normal aluminum orthosilicate, and which express completely all the known chemical relations of tourmaline.

On studying carefully all the more recent and more trustworthy analyses of tourmaline, a constant ratio appears connecting silicon, boron, and oxygen, which is represented by the figures $Si_6B_3O_{31}$. The variations from constancy are almost all within the limits of accuracy of the analyses, but occasionally a small amount of fluorine is noted, which appears to replace the univalent acid group BO_2. Aluminum, with respect to silicon, varies widely, the ratio ranging from Al_8Si_6 to Al_5Si_6, while the other bases vary reciprocally with aluminum and in the opposite direction. The tourmalines high in aluminum approach, like muscovite, most nearly to the normal ortho-salt; those lowest in aluminum are high in magnesium, like phlogopite; and, like biotite in the mica group, the iron tourmalines lie between these extremes.

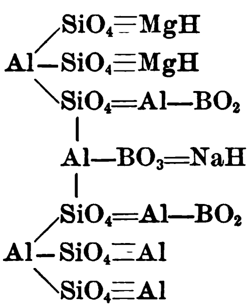
Taking now the smallest amount of *aluminum found in the formula* of any tourmaline, all varieties of the species may be regarded as containing the nucleus $Al_5(SiO_4)_6(BO_3)(BO_2)_2$, in which 14 units of affinity are still unsatisfied, and among which all of the essential variations in composition take place. The orthoboric group, BO_3, is obviously trivalent, BO_2 being univalent, and the radicle of metaboric acid.

From this nucleus four types of tourmaline are derivable, thus:

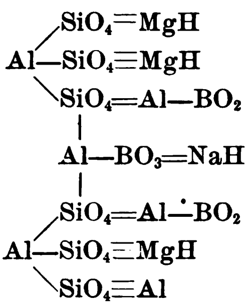
1.



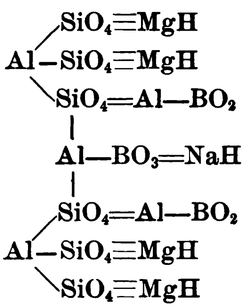
2.



3.



4.



and to all of these, known varieties of the mineral correspond. The only notable variations are due to Cr or Fe replacing Al, Fe or Mn replacing Mg, small quantities of F replacing BO_2, and in No. 4, Ca sometimes replacing NaH. If in No. 1 $R'_3 = LiH_2$, and in No. 2 Fe_2 replaces Mg_2, these formulæ give the subjoined percentage compositions:

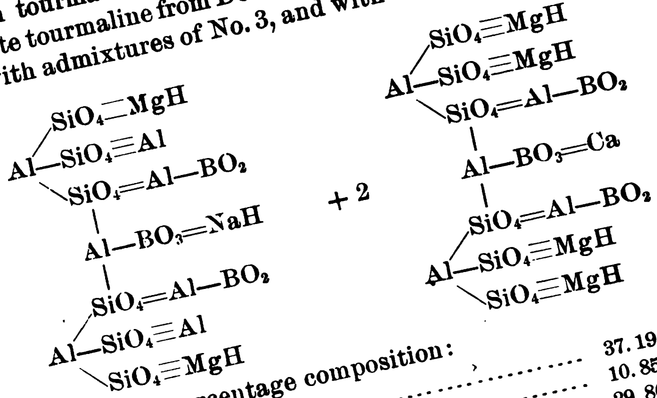
	1	2
SiO_2	38.05	35.16
B_2O_3	11.10	10.25
Al_2O_3	43.13	34.86
FeO	....	14.06
Na_2O	3.28	3.03
Li_2O	1.58	....
H_2O	2.86	2.64
	100.00	100.00

figures agree well with the best analyses of the and the ordinary black tourmalines which are found in the ities; divergencies being due to trifling admixtures of one with other, and to the presence of fluorine as previously noted. ormula No. 3 corresponds to

SiO_2	37.58
B_2O_3	10.96
Al_2O_3	31.34
MgO	12.52
Na_2O	3.24
H_2O	3.76
	100.00

which is very near the composition of the dark-brown tourmalines fron Orford, N. H., and Monroe, Conn., except that in them a little F. replaces Mg, and a little Ca takes the place of NaH.

The brown tourmalines of Hamburg, N. J., and Gouverneur, N. Y with the white tourmaline from DeKalb, all approximate toward formul No. 4, but with admixtures of No. 3, and with Ca in place of NaH. Th mixture



gives the following percentage composition:

SiO_2	37.19
B_2O_3	10.85
Al_2O_3	29.86
MgO	13.77
CaO	3.86
Na_2O	1.06
H_2O	3 41
	100.00

which represents the DeKalb tourmaline fairly well. In burg mineral there is more of the calcium compound, and in Gouverneur rather less. The black tourmaline from Pierre formula No. 4 very closely, except that about three-tenths has been replaced by Fe, and one-half of the NaH by Ca. for the following mixture of molecules:

$$3Al_5(SiO_4)_6(BO_2)_2BO_3NaFe_4H_5$$
$$2Al_5(SiO_4)_6(BO_2)_2BO_3NaMg_4H_5$$
$$5Al_5(SiO_4)_6(BO_2)_2BO_3CaMg_4H_4$$

we have the following comparison with *Riggs's analysis of Pierrepont* tourmaline:

	Found.	Calculated.
SiO_2	35.61	35.91
TiO_2	.55	
B_2O_3	10.15	10.48
F	.27	
Al_2O_3	25.29	25.44
Fe_2O_3	.44	
FeO	8.19	8.62
MgO	11.07	11.17
CaO	3.31	2.79
Na_2O	1.51	1.55
K_2O	.20	
H_2O	3.34	4.04
	99.93	100.00

Tourmalines which do not correspond to any one of the four types given agree with mixtures of them, and all of the analyses of this mineral published by Jannasch and Calb or by Riggs can be reduced to suitable formulæ. These formulæ suggest an end product,

$$Al_9(SiO_4)_6(BO_2)_2BO_3NaH$$

which may possibly exist, but is not known. They also indicate the obvious relationship of tourmaline to the micas, and express the ready alterability of the former into the latter. A molecule of tourmaline, with elimination of boric acid and one atom of aluminum, splits into two molecules of the mica type, and the transformation is easily understood. Potash is of course taken up. Certain experiments by Lemberg,* who investigated the action of alkaline solutions upon tourmaline, are in accord with these suppositions.

Although otherwise interpreted by Brögger, the minerals cappelinite, melanocerite, karyocerite, and tritomite seem to be structurally akin to tourmaline. This view of their nature has already been suggested by Wiik,† and it is sustained both by chemical and by morphological considerations. Cappelinite is hexagonal, and the other species, like tourmaline, are rhombohedral. They are silicates of rare earths, which are mostly trivalent, like aluminum; all contain boron, and all but cappelinite contain fluorine also. Furthermore, all four species, considered together, illustrate the reciprocity between boric acid and fluorine, which has been suggested in the discussion of tourmaline.

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* Zeitsch. Deutsch. Geol. Gesell., 1892, p. 239.

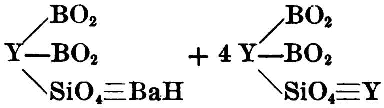
† Zeitsch. Kryst. Min., XXIII, pp. 421, 422, 1894.

Thus, if we compute the atomic ratios from the analyses cited by Brögger,* the following relation appears:

	Si.	B.	F.	B+F.
Cappelinite	236	488	....	488
Melanocerite	218	92	304	396
Karyocerite	216	134	296	430
Tritomite	226	210	226	436

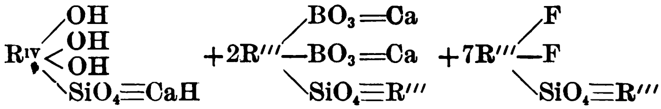
That is, Si:B + F::1:2 nearly, variations being due to the fact that in the first three minerals the boric acid was determined by difference, and also, probably, to the occasional replacement of fluorine by hydroxyl. Another source of variation is found in the presence of tetrad bases, as will be seen later; but for the moment the relation indicated seems to be reasonably clear.

The first member of the group, cappelinite, is a borosilicate of yttrium and barium, and approximates in composition to

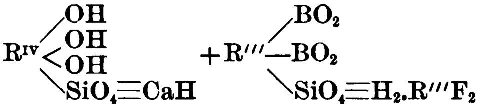


With the earths of uncertain molecular weight designated as "yttria," are a little lanthanum oxide and trifling quantities of ThO_2 and CeO_2, and with the barium are some calcium and alkalies.

The other three members of the group are all more complicated than cappelinite, and vary from it in type by containing tetrad oxides, such as CeO_2, ThO_2, and ZrO_2. In eudialyte and catapleiite we have two rhombohedral silicates of zirconia, which help to explain these compounds. Catapleiite probably has the constitution $(OH)_3Zr.Si_3O_8.R'_3$. If we regard the tetrad bases in the cappelinite group as forming orthosilicates of this same type, the remainder of each mineral may be written as a mixture of molecules like those already designated, but with cerium earths predominating over yttrium, and fluorine replacing some boric radicles. Thus, melanocerite is not far from



Karyocerite may be written similarly, and tritomite becomes



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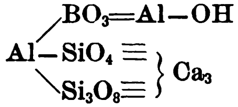
*Zeit. Kryst. Min., XVI, pp. 462–469.

These formulæ are uncertain, and need verification with material from other sources. At present they have only a reasonable probability. The tetrad silicate in them, however, will be seen to be highly probable when we come to the discussion of the other allied compounds in their proper connection later.

There is one other borosilicate containing aluminum, axinite, whose relations are uncertain. Physically it differs widely from tourmaline, being triclinic, but on account of its composition it may fairly be considered here. The analyses of it vary to a considerable extent, partly because of uncertainty in the determinations of water and boron, but also in other respects which indicate a mixture of molecules. Some analyses give orthosilicate ratios, provided that the boron is regarded as basic and equivalent to aluminum, but others show much too little oxygen. Boron, however, is essentially an acid-forming element, and it seems more probable that in axinite it has acid functions. The most typical axinite is that from Bourg d'Oisans, and of this the best analysis is by Jannasch and Locke.* From this the following formula is easily derived:



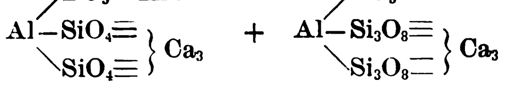
$$\mathrm{Al}\begin{array}{l} \diagup \mathrm{BO_3{=}Al{-}OH} \\ -\mathrm{SiO_4}\equiv \\ \diagdown \mathrm{Si_3O_8}\equiv \end{array}\!\!\left.\begin{array}{l} \\ \\ \end{array}\right\}\mathrm{Ca_3}$$

in which the boron is regarded as part of an orthoborate molecule, derived from the acid H_3BO_3.

This may be compared with Jannasch and Locke's analysis directly, and with the latter reduced by recalculating Fe_2O_3 into Al_2O_3, the other bases all into their equivalents in CaO, and then bringing to 100 per cent, thus:

	Found.	Reduced.	Calculated.
SiO_2	42.88	43.13	43.32
B_2O_3	6.02	6.06	6.32
Al_2O_3	18.24	18.73	18.41
Fe_2O_3	.62		
FeO	7.10		
MnO	1.06		
CaO	19.89	29.93	30.33
MgO	2.23		
K_2O	.11		
Na_2O	.36		
H_2O	2.14	2.15	1.62
	100.65	100.00	100.00

The formula may also be written



$$\mathrm{Al}\begin{array}{l} \diagup \mathrm{BO_3{=}AlOH} \\ -\mathrm{SiO_4}\equiv \\ \diagdown \mathrm{SiO_4}\equiv \end{array}\!\!\left.\begin{array}{l} \\ \\ \end{array}\right\}\mathrm{Ca_3} + \mathrm{Al}\begin{array}{l} \diagup \mathrm{BO_3{=}AlOH} \\ -\mathrm{Si_3O_8}\equiv \\ \diagdown \mathrm{Si_3O_8}= \end{array}\!\!\left.\begin{array}{l} \\ \\ \end{array}\right\}\mathrm{Ca_3}$$

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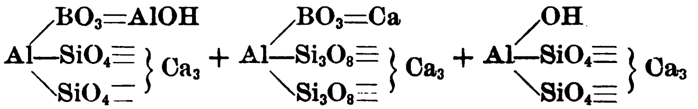
* Zeitsch. Anorgan. Chem., VI, p. 57, 1894.

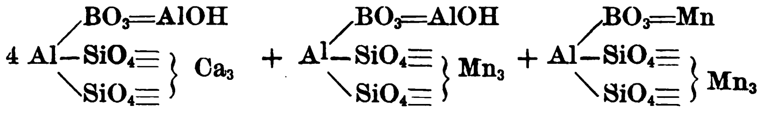
in which form it compares better with other analyses. Thus Baumert's analysis of axinite from the Radauthal* gives



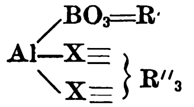
and a comparison as follows:

	Found.	Reduced.	Calculated.
SiO_2	40.76	40.92	41.32
B_2O_3	4.76	4.78	4.82
Al_2O_3	12.47	13.91	14.05
Fe_2O_3	2.17		
FeO	3.60	39.17	38.57
MnO	2.84		
CaO	30.21		
MgO	2.00		
H_2O	1.22	1.22	1.24
	100.03	100.00	100.00

Genth's analyses* of the axinite from Franklin, N. J., give similar ratios, minus the boron-free molecule required in Baumert's case. Approximately they give



with rather less than half the SiO_4 replaced by Si_3O_8. In general, when $X=Si_3O_8+SiO_4$ all axinite except that analyzed by Baumert gives the general formula



in which R″ is partly AlOH, with Ca, Mg, Mn, or Fe. Until further evidence is available this expression may be regarded as valid, but it represents only the composition of the mineral, and no other relations. It is, however, in conformity with the general theory of substitution. Other formulæ, which represent axinite either as metasilicate or as orthodisilicate, are possible, but none of them has any advantage over the one proposed.

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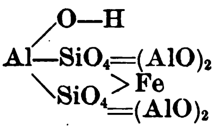
[*] Dana's System of Min., 6th ed., p. 529.

VII. MISCELLANEOUS SPECIES.

Among the ortho- and trisilicates of aluminum, ferric iron, and other triad elements, there are a considerable number which do not fall conveniently into any of the preceding groups of minerals, or which are doubtful as regards their genetic affinities. Some of them have obvious relationships to other species, and some are quite obscure in character, but all seem to be conformable to the theory of substitution.

First in order of importance is the mineral staurolite, a highly basic silicate, which is evidently akin to andalusite, dumortierite, and sillimanite, and which, like them, is orthorhombic. Like andalusite, furthermore, staurolite alters into muscovite, an entire crystal becoming transformed throughout into an aggregate of mica scales.

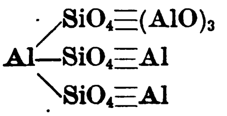
By far the best evidence as to the composition of staurolite is that furnished by the analyses of Penfield and Pratt,* who adopt Groth's formula $HAl_5Fe''Si_2O_{13}$. This, structurally, is best written



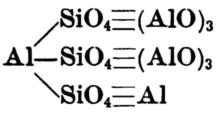
which expresses a partial relation to the micas, andalusite, and so on. The theoretical percentage composition calculated from this formula agrees well with the results of analysis, except that it gives the silica nearly one per cent too low, a discrepancy which Penfield and Pratt attribute to inclusions of silica in the minerals analyzed.

By means of a slightly different formula the relations of staurolite to the other species can be much more clearly shown, but it assumes that the ideal staurolite is not yet known. The expressions proposed are as follows:

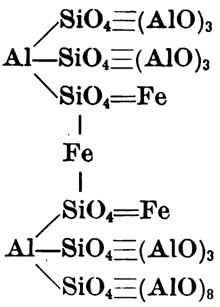
Andalusite.



Dumortierite.



Staurolite.



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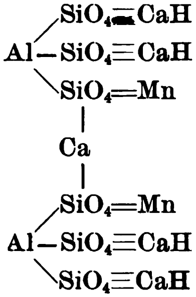
*Am. Jour. Sci., (3) XLVII, p. 81, 1894.

This formula, in contrast with that of Penfield and Pratt, and with their reduced analysis of staurolite from Lisbon, N. H., gives the subjoined percentage composition:

	Lisbon.	P. and P.	New formula.
SiO_2	27.44	26.32	27.90
Al_2O_3	55.16	55.92	55.35
FeO	15.72	15.79	16.75
H_2O	1.68	1.97	....
	100.00	100.00	100.00

If, now, we assume that the actual staurolite is slightly altered by hydration, some Fe being replaced by H_2 and by FeOH+H, the discrepancies between formula and analyses are sufficiently accounted for. The new formula is more symmetrical than the old one; it better expresses the alterability of staurolite into muscovite, and it seems to satisfy the evidence with sufficient completeness. When we remember that staurolite is excessively liable to inclusions and alterations, a very sharp agreement between analysis and theory is not to be expected.

Still another orthorhombic species, harstigite, has a formula analogous in some ways to that of staurolite. For harstigite there is but one analysis extant, which gives, nearly

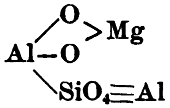


This, in comparison with Flink's analysis, gives

	Found.	Calculated.
SiO_2	38.94	39.13
Al_2O_3	10.61	11.09
MnO	12.81	15.43
MgO	3.27	
CaO	29.23	30.44
K_2O	.35	
Na_2O	.71	
H_2O	3.97	3.91
	99.89	100.00

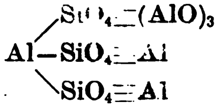
a result which is fairly satisfactory. More data relative to harstigite are evidently needed.

In order to interpret the clintonite micas, the highly basic compound



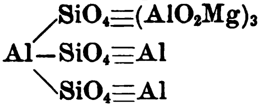
$$\mathrm{Al}\begin{cases}\left.\begin{array}{l}\mathrm{O}\\ \mathrm{O}\end{array}\right\rangle\mathrm{Mg}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$

was assumed. This formula also gives, empirically, the percentage composition of the species kornerupine or prismatine, which, unlike the micas, is orthorhombic, and also insoluble in acids. On these grounds it may be compared with andalusite and staurolite; and a clew to its constitution is found in the existence of an alteration product of prismatine, kryptotile, having the composition $HAlSiO_4$. Tripling the formulæ, we have



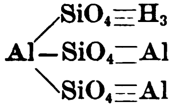
Andalusite.

$$\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv(AlO)_3}\\ \mathrm{SiO_4\equiv Al}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$



Kornerupine.

$$\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv(AlO_2Mg)_3}\\ \mathrm{SiO_4\equiv Al}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$



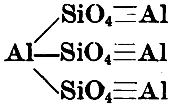
Kryptotile.

$$\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv H_3}\\ \mathrm{SiO_4\equiv Al}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$

symbols which express the observed relationship between these and other species. Further than this the formulæ have no real significance, and alternative expressions are considered later in connection with the pyroxenes and amphiboles. Associated with kornerupine the still more basic sapphirine, $Mg_5Al_{12}Si_2O_{27}$, is found. To the constitution of this species there is no good clew, and any attempt at structural formulation is useless. More than one structural formula is possible for sapphirine, but all are at present meaningless, except in so far as they show that the compound is stoichiometrically conceivable.

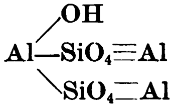
A peculiarly difficult group of minerals to interpret constitutionally is the group of clays. One member of this group, kaolin, has already been considered, and this member has the advantage of being crystalline. The other clays are amorphous, and of uncertain origin; they often occur in complicated mixtures, are difficult to identify with certainty, and still more difficult to correlate with other species. They represent undoubtedly the breaking down of crystalline silicates, to which they are related somewhat as kaolin is related to the feldspars; but rarely, if ever, has their actual genesis been observed. Their formulæ, therefore, are merely tentative, and serve only as a first step toward a better study of the several species.

Upon comparing the formula of aluminum orthosilicate with that of kaolin, an indication of serial arrangement becomes evident, which may be written thus:



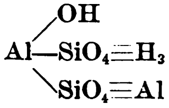
Normal salt.

$$\mathrm{Al}\begin{cases}\mathrm{SiO_4\equiv Al}\\ \mathrm{SiO_4\equiv Al}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$



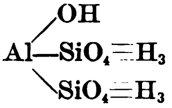
Westanite or woerthite.

$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{SiO_4\equiv Al}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$



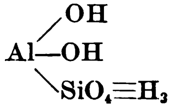
Kaolin.

$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{SiO_4\equiv H_3}\\ \mathrm{SiO_4\equiv Al}\end{cases}$$



Montmorillonite.

$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{SiO_4\equiv H_3}\\ \mathrm{SiO_4\equiv H_3}\end{cases}$$



Newtonite.

$$\mathrm{Al}\begin{cases}\mathrm{OH}\\ \mathrm{OH}\\ \mathrm{SiO_4\equiv H_3}\end{cases}$$

Woerthite is an altered sillimanite, and westanite is perhaps a similar derivative of andalusite. The newtonite compound has already appeared in the mica series among the components of cookeite and rumpfite.

The best that can be said for these formulæ is that they are suggestive. In one respect they are highly questionable, for the reason that the group $—SiO_4\equiv H_3$ is indicative of loosely combined water, while in these particular clays the water is quite firmly retained. On this point much fuller information is needed, and future evidence may prove that the serial relation indicated is apparent only.

The composition of rectorite may be $Al_3(SiO_4)_3H_3+2H_2O$, or that of a hydrous kryptotile. Halloysite has the composition of kaolin plus one molecule of water, the latter being removable at or about 100°. Halloysite, however, differs from kaolin in being decomposable by hydrochloric acid, and hence it is unlikely that the two species have similar structure. Allophane is perhaps $(AlO_2H_2)_2H_2SiO_4+3H_2O$, or it may be written analogously to andalusite,

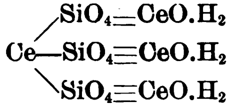
$$Al_3(SiO_4)_3(AlO_2H_2)_3.12H_2O.$$

Neither formula is sustained by any good evidence. Other clays are possibly as follows:

Samoite	$Al_4(SiO_4)_3.10H_2O$
Cimolite	$Al_4(Si_3O_8)_3.6H_2O$
Collyrite	$(AlO)_4SiO_4.6H_2O$
Schrötterite	$(AlO_2H_2)_4SiO_4.6H_2O$

None of these formulæ can be construed as anything more than a temporary suggestion, which may help research. The hydrous ferric silicates are, if anything, less satisfactory than the aluminum salts. Anthosiderite is representable by the formula $Fe_4(Si_3O_8)_3.2H_2O$; and chloropal by the expression $Fe_2(SiO_4)_3H_6$. Hisingerite seems to range from a ferric kaolin to a ferric halloysite, and farther than this it is not worth while to go. The remaining iron clays which have received specific names are altogether doubtful. The chromium clays, wolchonskoite, etc., are also of uncertain character.

To cerite, which is of doubtful composition, the provisional formula



$$Ce\begin{cases} SiO_4\equiv CeO.H_2 \\ SiO_4\equiv CeO.H_2 \\ SiO_4\equiv CeO.H_2 \end{cases}$$

may be assigned. Other earth metals—lanthanum, the two didymiums, etc.—replace a considerable part of the cerium. With cerium only the formula requires

SiO_2	20.22
Ce_2O_3	73.71
H_2O	6.07
	100.00

Cenosite, $H_4Ca_2Y_2CSi_4O_{17}$, and ardennite, $H_5Mn_4Al_4VSi_4O_{23}$, can each be written structurally in more than one way, with no determining evidence upon which to base a decision. They may be orthosilicates or diorthosilicates; the vanadium in ardennite may be combined as VO_3 or as VO_4, or it may form part of a complex vanadio-silicic acid, and between these alternatives there is no present means of deciding. To carpholite the formula $H_4MnAl_2Si_2O_{10}$ is commonly assigned, but the analyses vary from this composition too widely. Even with this formula carpholite may be either an orthosilicate or a basic metasilicate, and we can only say with regard to this species that further investigation is necessary.

Spodumene, acmite, jadeite, and the corresponding members of the amphibole group will be considered in connection with the metasilicates. It is quite possible that these minerals are really pseudo metasilicates, and that they should properly be discussed now. Their study is deferred on mineralogical grounds solely.

Three other salts of triad bases may be noted here, as having more analogy with the salts of aluminum than with any other silicates. They are pseudobrookite, an orthotitanate of iron, $Fe_4(TiO_4)_3$, and the bismuth silicates, eulytite and agricolite, $Bi_4(SiO_4)_3$. The two last-named species differ in form but are identical in empirical composition. They, therefore, suggest two types of chemical structure among the silicates of trivalent bases.

CHAPTER IV.

THE ORTHOSILICATES OF DYAD BASES.

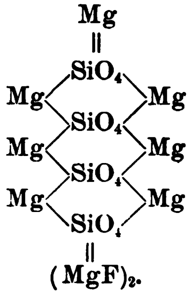
Although the orthosilicates of the dyad metals are presumably simpler than those of aluminum, the problem of their constitution, studied in the light of mineralogical evidence, is peculiarly difficult. Starting points exist, in the salts of magnesium, iron, manganese, zinc, and glucinum, but the derivatives are fewer than in the case of aluminum, and the evidence upon which to base argument is proportionally limited.

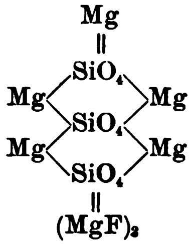
Expressed in the simplest terms, the normal orthosilicates of this group are represented by the general formula R_2SiO_4. To this type the following minerals correspond:

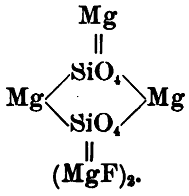
Forsterite	Mg_2SiO_4
Fayalite	Fe_2SiO_4
Tephroite	Mn_2SiO_4
Willemite	Zn_2SiO_4
Phenakite	Gl_2SiO_4
Monticellite	$CaMgSiO_4$
Knebelite	$MnFeSiO_4$

Between these minerals there are many intermediate species or varieties, which may be either isomorphous mixtures or double salts representing polymers of the fundamental type. Thus, chrysolite or olivine may be a mixture of forsterite and fayalite, or, in the case of hyalosiderite, a salt of the formula $Mg_4Fe_2(SiO_4)_3$. So also, allied to knebelite, we have igelströmite, $Fe_4Mn_2(SiO_4)_3$; and in trimerite we find the salt $Gl_3Mn_2Ca(SiO_4)_3$.

Upon studying closely the derivatives of these normal salts, the assumption of polymerization seems to be necessary. If the theory of substitution is valid, then the existence of polymers must be taken for granted; and upon this basis it becomes possible to develop a system of formulæ which satisfies all the conditions imposed by the evidence now at hand. For some of the species already mentioned the degree of polymerization is difficult to determine, and synthetic investigations seem to be needed. In other cases the problem is comparatively simple, and the indications as to the true formulæ are apparently clear. For instance, a good example is furnished by the chondrodite group, fo which we have the empirical formulæ *established by Penfield and Howe.*[*] Structurally written these become

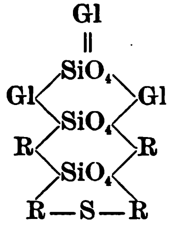

Clinohumite.


Humite.


Chondrodite.

or derivatives respectively of the salts $Mg_8(SiO_4)_4$, $Mg_6(SiO_4)_3$, and $Mg_4(SiO_4)_2$, with one atom of magnesium in each case replaced by the two univalent —Mg—F groups. The clinohumite occurs in association with forsterite, and the two species have nearly the same specific gravity. Hence forsterite may be $Mg_8(SiO_4)_4$, and this is the only datum available from which to infer its molecular magnitude. The synthetic transformation of forsterite into clinohumite, if it could be effected, would go far toward settling the question.

In the case of phenakite the triple formula $Gl_6(SiO_4)_3$ is rendered probable by the existence of trimerite, $Gl_3Mn_2Ca(SiO_4)_3$. It is also emphasized by the species helvite and danalite, which contain sulphur, probably combined in the dyad group —R—S—R—. Both of these species, in all of their known occurrences, agree with the general formula



in which R may be either Fe″, Mn, or Zn. The R is variable, but the other constituents are constant. In helvite, Mn and Fe occur, and in danalite zinc appears. In the Colorado danalite Zn predominates largely over Fe, and there is very little Mn. The Rockport danalite has Fe in excess of Zn, and rather more Mn. The Cornish danalite is very low in Zn, and the Fe largely exceeds the Mn. The ratio $Gl:SiO_4::3:3$, however, holds for all.

If phenakite is $Gl_6(SiO_4)_3$, then willemite, which is morphologically similar, is probably $Zn_6(SiO_4)_3$, with zinc partly replaced by manganese in the variety known as troostite.

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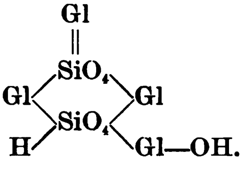
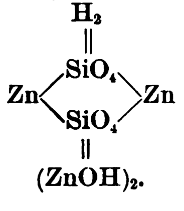
[*] Am. Jour. Sci. (3), XLVII, p. 188, 1894.

The three orthorhombic species, bertrandite, calamine, and ilvaite, may be most conveniently represented as derivatives of the bipolymer $R_4(SiO_4)_2$, like chondrodite. Crystallographically, ilvaite resembles humite, but bertrandite and calamine are related to each other. The simplest analogous formulæ for the three minerals are as follows:

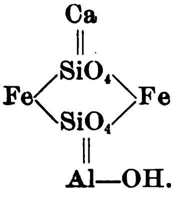
Bertrandite.



Calamine.



Ilvaite.



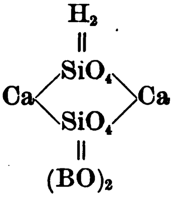
Calamine may also be written as a metasilicate, $(ZnOH)_2SiO_3$, with half of the formula indicated above, but then the analogy with bertrandite disappears. The structure proposed is, therefore, preferable, at least until more evidence has been accumulated.

To the datolite group a similar constitution is ascribable. The species, reduced to their simplest empirical expressions, are these:

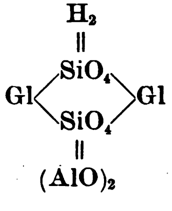
Datolite	$HCaBSiO_5$
Homilite	$Ca_2FeB_2Si_2O_{10}$
Euclase	$HGlAlSiO_5$
Gadolinite	$Gl_2FeY_2Si_2O_{10}$

By doubling the formulæ of datolite and euclase, all four of the minerals become similar in constitution. Hydrogen, here, is evidently basic, and boron must play the same part as aluminum and yttrium. Assuming these elements to be present in the univalent groups BO, AlO, and YO, the subjoined formulæ follow:

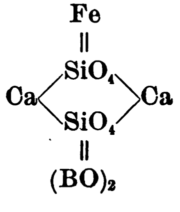
Datolite.



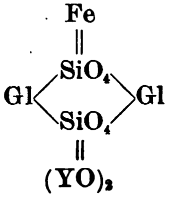
Euclase.



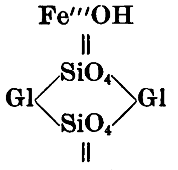
Homilite.



Gadolinite.



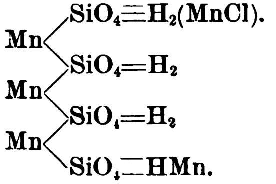
Gadolinite alters with great ease, passing by hydration into a brownish-red earthy substance. The analyses of this substance, which is probably never pure and definite, are not altogether satisfactory; but they indicate in a general way a transformation into the compound



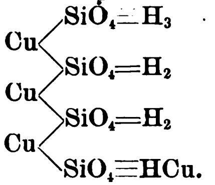
to which the alteration product very roughly approximates.

It will be observed that all of the foregoing structural formulæ in this group of compounds are rings or series of rings. From them, however, chain-like molecules are derivable, and these seem to exist in the cases of friedelite, pyrosmalite, and dioptase. The last-named mineral, simply written, is CuH_2SiO_4; but it is morphologically related to the two other species, which have a much greater complexity of composition. The following expressions derived from the polymer $R_8(SiO_4)_4$ are probably the best to represent existing evidence:

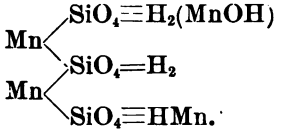
Friedelite.



Dioptase.



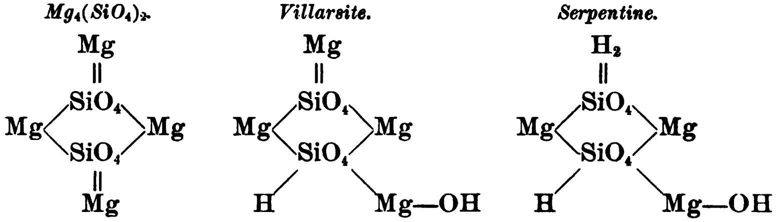
Pyrosmalite is like friedelite, but with a large part of the manganese replaced by iron. Possibly karyopilite may be similar, having the formula



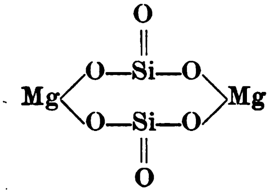
These formulæ are purely tentative and need additional support. By synthetic and genetic investigations they may be supported or overthrown. That they sustain one another, and fit in well with the formulæ of the preceding species, is all that can be said in their favor.

For serpentine, $H_4Mg_3Si_2O_9$, several formulæ are possible, and concerning them there has been much discussion. The species commonly originates in nature from the alteration of olivine on the one hand and from pyroxene or amphibole on the other, and it is therefore conceivable that it may include two or more isomeric compounds. In favor of this supposition there is no direct evidence, but still it should not be left entirely out of account.

By some authorities serpentine is regarded as an orthosilicate, and by others as a salt of the acid $H_6Si_2O_7$. On the latter supposition it becomes $Mg{=}Si_2O_7{\equiv}H_2(MgOH)_2$, which may be derived either from $2\,Mg_2SiO_4$ or $2\,MgSiO_3$, with loss of magnesium in one case and gain in the other. On the orthosilicate basis it is simply derivable from the polymer $Mg_4(SiO_4)_2$, and is related to the intermediate alteration product villarsite, as follows:



On this scheme the formula for serpentine corresponds with that of chondrodite; and the fact that the latter mineral alters readily into serpentine is strong evidence in its favor. If pyroxene is written structurally



the derivation of serpentine from it by action of infiltrating magnesian solutions becomes easy to understand, and the orthosilicate formula for serpentine is rendered still more probable. In short, that formula best indicates the genetic relationships of serpentine, and on these grounds is preferable to the alternative diorthosilicate expression. The latter is not disproved; it is simply rendered less advantageous as regards existing evidence, which is the evidence now to be interpreted.

In some former investigations, carried on jointly with Dr. Schneider,* I sought to obtain experimental data in support of the orthosilicate formula here assigned to serpentine. By acting on serpentine with dry gaseous hydrochloric acid we found that a part of the magnesium could be removed as chloride, while olivine and the magnesian micas were not attacked. At first it seemed probable that the reaction would give a quantitative measure of the magnesium combined as MgOH; but our later experiments and those of Lindner† have shown that the expectation was not well founded. I still believe, however, that the reaction discriminates between those magnesian silicates which contain MgOH and those which contain Mg and H combined otherwise; for only the members which must belong to the first class are acte upon by the reagent. Brauns's objections[*] to this supposition, on the ground that the dry hydrochloric acid becomes moist, are not well taken, for the reaction was always applied at temperatures lower than those at which water is given off. His criticisms may apply to the later stages of the reaction, after it has once fairly begun, but not to its initiation. The magnesian micas which contain several per cent of water are all decomposable by aqueous hydrochloric acid, but are scarcely touched by the dry gas, while on the other hand serpentine and the chlorites are strongly attacked. After the gaseous acid has acted it becomes moist, but very slowly, and most of the moisture is carried past the mineral under investigation before it has had time to produce an appreciable effect. It is possible, however, that a slow stream of the acid may act differently from a rapid current, and that the discordant results of observation may be due to differences of this kind.

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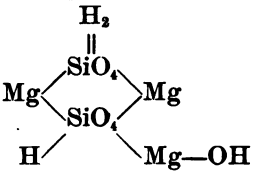
* Bull. U. S. Geol. Survey No. 78, p. 11; Bull. No. 90, p. 11, and Bull. No. 113, pp. 27 and 34.

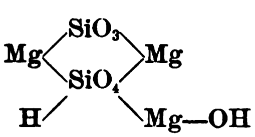
† A. Lindner, Inaugural Dissertation, Breslau, 1893.

When serpentine is ignited, water is expelled, and a residue having the composition $Mg_3Si_2O_7$ is left behind. According to Rammelsberg[†] the water is given off in two portions—one-half upon weak ignition, the other after heating more strongly. On the orthosilicate theory these stages may be represented thus:

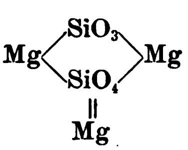
Serpentine.



First stage.

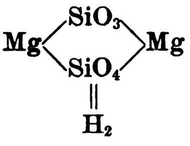


Second stage.



At the end of the second stage, if the ignition has not been too intense, the residue is still decomposable by hydrochloric acid, but by prolonged heating it is broken up quantitatively into soluble olivine and insoluble enstatite.

Allied to serpentine is the somewhat doubtful picrosmine, to which the formula $Mg_2H_2Si_2O_7$ is commonly assigned. Although this expression suggests a diorthosilicate, it may also be written



which represents picrosmine as a dehydrated serpentine altered subsequently by rehydration, with replacement of one magnesium atom by two of hydrogen. This mode of interpretation brings the mineral into line with serpentine, and all the known relations of the species are adequately expressed

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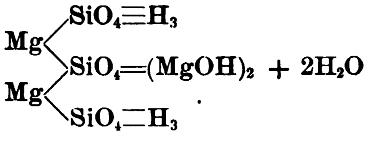
[*] Neues Jahrbuch, 1894. I, p. 205.

[†] Handbuch der Mineralchemie, 2 Aufl., p. 506.

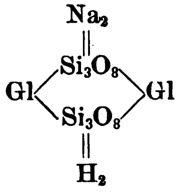
Several other hydrous silicates of magnesium seem to belong in this group, but their nature is altogether doubtful. Thus we have

Aphrodite	$Mg_2H_4(SiO_4)_2$
Kerolite	$Mg(SiO_4)_2H_5(MgOH)$

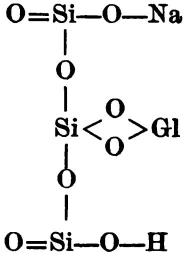
Deweylite is possibly



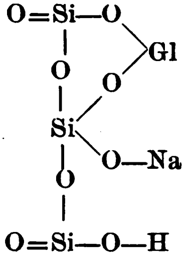
and genthite is similar, with part of the magnesium replaced by nickel. Sepiolite may be a trisilicate, with the formula $H_2=Si_3O_8=(MgOH)_2$, in which case conarite is the corresponding nickel salt. These symbols are to be regarded as suggestions only. Two other trisilicates—eudidymite and epididymite—should also be noted at this point. The two species have the same empirical formula, $HNaGlSi_3O_8$, which, doubled, becomes



a structure conformable to the type of the orthosilicates already considered. The isomerism between eudidymite and epididymite is explainable by giving one species the constitution just written, while the other, in place of Na_2 and H_2, would have the two groups NaH. It can also be ascribed to a different linking with the oxygen of the acid, and the empirical formula $HNaGlSi_3O_8$ can be put in two forms, thus:



and



a third isomer being also conceivable. The doubled formula, however, brings out analogies with bertrandite and other species and therefore, in default of evidence, is to be preferred.

CHAPTER V.

THE ORTHOSILICATES OF TETRAD BASES.

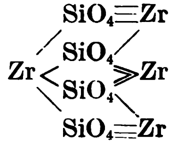
On account of their relatively small number and general scarcity, the silicates of the tetrad metals, titanium, zirconium, and thorium, are difficult to interpret in any satisfactory manner. Evidence exists, however, which seems to show that they are explainable by the same principles which apply to aluminum and the dyads, and that the theory of substitution from normal salts is a good working hypothesis to start from.

One definite normal salt is known in this series, the mineral zircon, $ZrSiO_4$. As with the other inorganic silicates, the true molecular weight of this compound is unknown, and it can be inferred only from a study of its derivatives. If we assume it to be represented by the polymeric expression $Zr_4(SiO_4)_4$, it contains replaceable basic atoms, and a number of other zirconium silicates fall naturally into series derivable from this as the fundamental member. In this connection the mineral auerbachite is peculiarly suggestive, for its composition is best indicated by the formula $Zr_4(Si_3O_8)(SiO_4)_3$; which goes to show an important analogy between this group of silicates and those which have been previously considered. This formula, compared with Hermann's analysis of auerbachite, gives the following results:

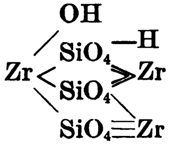
	Hermann.	Calculated.
SiO_2	42.91	42.45
ZrO_2	55.18	57.55
FeO	.93	....
H_2O	.95	....
	99.97	100.00

Although zircon is a very stable and definite mineral, it alters by hydration into malacone, cyrtolite, and a variety of other indefinite substances which can not as yet be interpreted with any clearness. At the same time other bases, such as lime and the rare earths, are taken up, producing mixtures of great complexity. Malacone is probably the first hydration derivative, and its relations to zircon, regarding the latter as $Zr_4(SiO_4)_4$, may possibly be as follows:

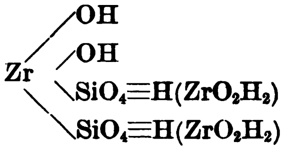
Zircon.



Malacone.



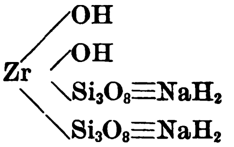
The original cyrtolite from Rockport is near malacone, but the cyrtolite from Colorado, analyzed by Hillebrand, approximates to



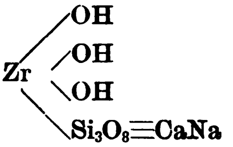
with part of the ZrO_2H_2 replaced by other bases. These formulæ, taken by themselves, are entitled to little consideration; but they become more significant when studied in connection with other compounds later. It will be noticed that one atom of zirconium is represented as linking four groups or radicles together; just as one aluminum atom has a similar triple function in the aluminous orthosilicates. This mode of linkage will be followed throughout this group of compounds.

In eudialyte, elpidite, and catapleiite we have a group of zirconium silicates which form a highly suggestive series. Taking the simpler members first, they may be represented thus:

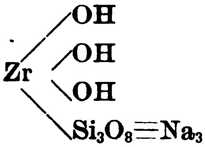
Elpidite.



Lime catapleiite.

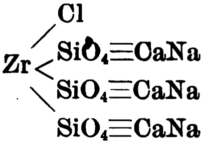


Soda catapleiite.

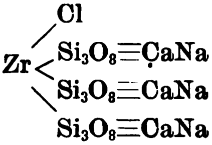


Connecting these formulæ with zircon, we have the facts that Si_3O_8 occurs in auerbachite, and that at Låven, according to Brögger,* zircon is found both intergrown with catapleiite and pseudomorphous after it.

Eudialyte and eucolite are commonly regarded as metasilicates, with the compound $ZrOCl_2$ as an admixture. But the latter is not found in nature by itself, and both minerals, unlike most of the true metasilicates, gelatinize with acids. Furthermore, the analyses of eudialyte and eucolite show a considerable range of variation in the ratio Si : O, although approximating somewhat nearly to the assumed SiO_3. If now we treat eudialyte and eucolite as mixtures of tri- and orthosilicates, like the feldspars, scapolites, and some micas, all difficulties vanish, the chlorine becomes equivalent to hydroxyl, and the minerals fall into line with catapleiite and elpidite as the first members of the series. All varieties of eudialyte and eucolite are then interpretable as mixtures of the two molecules



and



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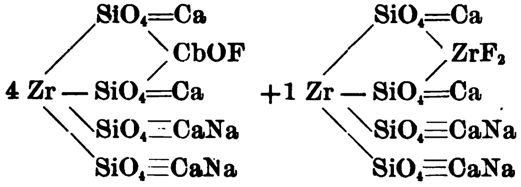
* Zeitsch. Kryst. Min., XVI, p. 105.

commingled in ratios nearly, but not exactly, 1 : 1. Hydroxyl replaces chlorine to some extent, while iron and manganese partly replace calcium; but the ratios shown by the formulæ are constant, and the structural analogies with the allied species are perfectly clear.

The remaining zirconium silicates, wöhlerite, rosenbuschite, låvenite, and hiörtdahlite, are difficult to formulate conclusively. Brögger regards them as meta compounds, and as such they are classed with the pyroxenes; but the ratio Si : O is in each case very nearly 1 : 4. In wöhlerite, which contains columbium, the latter pentavalent element may be regarded as forming the dyad group =CbOF, and as equivalent to the similar group $=ZrF_2$. On this supposition wöhlerite can be written



with small amounts of the groups R‴F replacing ZrF_2. As thus written the calculated composition agrees fairly with Cleve's analysis, thus:

	Cleve.*	Calculated.
SiO_2	30.14	30.27
TiO_2	.42	18.46
ZrO_2	16.12	
Cb_2O_5	12.85	13.52
Fe_2O_3	.48	....
Ce_2O_3	.66	....
FeO	1.26	28.26
MnO	1.00	
MgO	.12	
CaO	26.97	
Na_2O	7.50	7.83
H_2O	.74	....
F	2.98	2.87
	101.24	101.21
Less O	1.24	1.21
	100.00	100.00

* Zeit. Kryst. Min., XVI, p. 347.

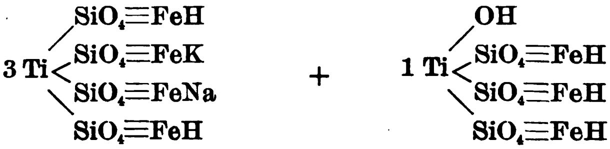
The other "zircon pyroxenes" can be interpreted in a somewhat similar manner, but the results are less satisfactory. The analyses are complicated by the presence of small amounts of titanium, which may be either acid or basic, and more data are needed before formulation can become useful.

The typical silicate of thorium, thorite, or orangite is another unsatisfactory species on account of its wide variations in composition. It is commonly supposed that the mineral, as it exists in nature, has been derived from an original $ThSiO_4$ by hydration; and that that $ThSiO_4$ was isomorphous with zircon. The nearest approach to the type is found in orangite, which may perhaps be regarded as a thorium cyrtolite, or thorium malacone. Yttrialite approximates to the composition

$$Th(Si_3O_8)_4Fe''_2(YO)_8$$

and in steenstrupine a thorium silicate exists which may be $Th(SiO_4)_4Ca_4Na_4$. Further discussion of these minerals at present would be fruitless. The data are wholly inadequate.

To the titanium silicates astrophyllite, johnstrupite, and rinkite similar formulæ to the foregoing are assignable. Indeed, this has already been done for astrophyllite by Brögger, who writes the formula $Ti(SiO_4)_4R''_4R'_4$. This seems to be the dominant molecule in astrophyllite, which, however, varies in composition. To the Colorado mineral we may more precisely give the formula



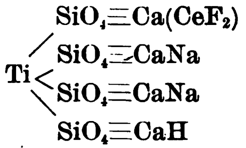
$$3\,\mathrm{Ti}\left<\begin{array}{l}SiO_4\equiv FeH\\ SiO_4\equiv FeK\\ SiO_4\equiv FeNa\\ SiO_4\equiv FeH\end{array}\right. + 1\,\mathrm{Ti}\left<\begin{array}{l}OH\\ SiO_4\equiv FeH\\ SiO_4\equiv FeH\\ SiO_4\equiv FeH\end{array}\right.$$

which requires

SiO_2	34.30
TiO_2	12.20
FeO	41.16
K_2O	5.36
Na_2O	3.55
H_2O	3.43
	100.00

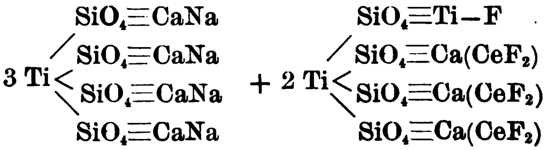
Some iron is replaced by manganese, and ferric iron, perhaps as $=Fe-OH$, is also present. In the fluoriferous astrophyllites the fluorine should replace hydroxyl.

Johnstrupite and rinkite are both fluoriferous, and both contain earths of the cerium groups. In johnstrupite, a little ZrO_2, ThO_2, and CeO_2 replace some TiO_2. For johnstrupite the expression



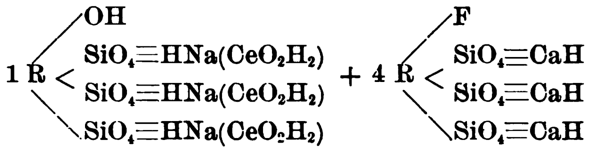
$$\mathrm{Ti}\left<\begin{array}{l}SiO_4\equiv Ca(CeF_2)\\ SiO_4\equiv CaNa\\ SiO_4\equiv CaNa\\ SiO_4\equiv CaH\end{array}\right.$$

agrees well with the ratios given by analysis. In rinkite we have, with great probability, the mixture



$$3\,\mathrm{Ti}\left<\begin{array}{l}SiO_4\equiv CaNa\\ SiO_4\equiv CaNa\\ SiO_4\equiv CaNa\\ SiO_4\equiv CaNa\end{array}\right. + 2\,\mathrm{Ti}\left<\begin{array}{l}SiO_4\equiv Ti-F\\ SiO_4\equiv Ca(CeF_2)\\ SiO_4\equiv Ca(CeF_2)\\ SiO_4\equiv Ca(CeF_2)\end{array}\right.$$

Even the complex mosandrite reduces to the same general type agreeing very closely with



$$1\,R<\begin{matrix}OH\\ SiO_4\equiv HNa(CeO_2H_2)\\ SiO_4\equiv HNa(CeO_2H_2)\\ SiO_4\equiv HNa(CeO_2H_2)\end{matrix} + 4\,R<\begin{matrix}F\\ SiO_4\equiv CaH\\ SiO_4\equiv CaH\\ SiO_4\equiv CaH\end{matrix}$$

in which $R=Ce^{iv} : Zr : Ti :: 1 : 2 : 2$. For each of these species the published analyses agree well with the composition calculated from these formulæ.

There is still another group of titaniferous silicates, represented by sphene, keilhauite, and tscheffkinite, which seems to be unconformable with the foregoing scheme of interpretation. Sphene, the typical member of the group, has the empirical formula $CaTiSiO_5$, for which two distinct structures have been proposed. One regards the mineral as the calcium salt of an acid, H_2TiSiO_5, analogous to $H_2Si_2O_5$, while the other treats it as a basic orthosilicate,

$$Ca=SiO_4=TiO.$$

A careful study of the recorded analyses of sphene leads me to prefer the latter expression, for the actual ratios vary in a way which indicates a replacement, sometimes of Ca and sometimes of TiO by other bases. On the meta formula, only the calcium should be replaceable. This variability of ratio is well shown by some of the varieties of sphene, such as grothite, alshedite, and eucolite-titanite, but the data are not absolutely conclusive. If, however, sphene is a basic orthosilicate, it should be placed in the preceding chapter with datolite and the other calcium salts. On the other hand, the acid character of the titanium is suggested by the remarkable hydration derivative of sphene, xanthitane, of which the composition is approximately represented by the formula $Al\equiv Ti_2O_7\equiv H_3$.

For tscheffkinite, as shown by Eakins' analyses, the composition is approximately $(FeCa)_3Ce_6Ti_4Si_6O_{32}$, but the constitution of the mineral is very doubtful. Keilhauite appears to be like sphene, with Ca or TiO replaced by $R'''OH$ or $R'''O_2H_2$, but the analyses are widely discordant. The orthorhombic guarinite is generally assumed to be isomeric with sphene, although there is but one incomplete analysis from which to calculate.

Some light may possibly be shed upon the sphene groups of mineral by a study of the columbo-titanates æschynite and polymignite. The composition of æschynite is very well represented by a mixture of molecules

$$\begin{gathered}2O=Ti=TiO_4=Ca\\ 2\,(CbO_3)_2=Ti=TiO_4=Fe\\ 3\,(CbO_3)_2=Th=TiO_4=(CeO)_2\end{gathered}$$

which compares with Rammelsberg's analysis as follows:

	Found.	Calculated.
TiO_2	21.20	20.70
ThO_2	17.55	18.63
Cb_2O_5	32.51	31.52
$(Ce, La, Di)_2O_3$	19.41	23.14
$(Y, Er)_2O_3$	3.10	
FeO	3.34	3.38
Ca	2.50	2.63
	99.61	100.00

For polymignite a similar expression gives equally good results. It is

$$
\begin{array}{l}
5\ (CbO_3)_2{=}Zr{=}TiO_4{=}(Fe'''O)_2 \\
4\ O{=}Zr{=}TiO_4{=}(CeO)_2 \\
15\ O{=}Zr{=}TiO_4{=}Ca \\
1\ O{=}Th{=}TiO_4{=}Na_2
\end{array}
$$

The similarity in type of these expressions to the orthosilicate formula for sphene is obvious. It is also obvious that the entire group is greatly in need of further study.

CHAPTER VI.

THE DIORTHOSILICATES.

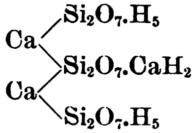
Although the existence of the sexbasic acid $H_6Si_2O_7$ has been well established by the preparation of its ethers, its metallic salts are little known and uncertain. I have already shown, in the case of serpentine, that a mineral may be apparently a diorthosilicate, and yet equally well explainable otherwise; and what is true in that instance may be true in others. For the following species the diorthosilicate formulæ seem to be the best and simplest, even though they are not wholly free from objection. They fit existing evidence, but are not absolutely conclusive.

The typical member of this group of minerals is the hexagonal lead silicate, barysilite, $Pb_3Si_2O_7$. The artificial compound from the slags of Bonneterre, Mo., described by Dana and Penfield, is near this, and may have the composition $Pb_2CaSi_2O_7$. The tetragonal ganomalite is another similar compound, approximating to $3Pb_3Si_2O_7+2Ca_3Si_2O_7$, although the latest analysis agrees rather better with $Pb_3Si_2O_7+Ca_2SiO_4$. Two other orthorhombic species, kentrolite and melanotekite, may be regarded as basic salts derived from barysilite, thus:

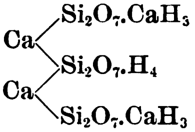
Barysilite	$Pb_2Si_2O_7Pb$
Melanotekite	$Pb_2Si_2O_7(Fe'''O)_2$
Kentrolite	$Pb_2Si_2O_7(Mn'''O)_2$

The group of zeolitic calcium silicates, okenite, gyrolite, and apophyllite, are unquestionably related to one another, and are best represented as salts of $H_6Si_2O_7$. In nature, gyrolite may be derived from apophyllite, and apophyllite also from gyrolite, while Doelter has generated apophyllite from okenite by artificial means.[*] First, by heating okenite with potassium silicate and water to 200°, crystals of apophyllite were obtained. Secondly, by heating okenite with aluminum chloride, sodium carbonate, and carbonated water together at 220°, apophyllite, analcite, and chabazite were produced. The most satisfactory general formulæ for the three species are these:

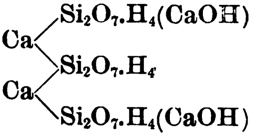
Okenite.



Gyrolite.



Apophyllite.



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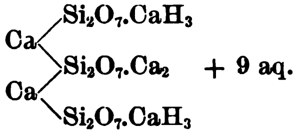
[*] Neues Jahrb., 1890, I, p. 118.

In apophyllite fluorine may partly replace hydroxyl, and K may replace the univalent CaOH. With K : CaOH : : 1 : 1 the composition of apophyllite becomes

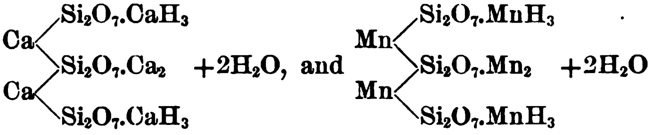
SiO_2	52.03
CaO	24.27
K_2O	6.79
H_2O	16.91
	100.00

The uncertain mineral plombierite may be a fourth member of this group, with the formula



$$\begin{matrix} & Si_2O_7.CaH_3 \\ Ca & \\ & Si_2O_7.Ca_2 \\ Ca & \\ & Si_2O_7.CaH_3 \end{matrix} + 9\ aq.$$

To the calcium-manganese silicate, inesite, various formulæ are assignable. By Flink it is regarded as $2(CaMn)SiO_3.\ H_2O$. But part of the water is stable at temperatures above 300°; and this fact is expressed by Schneider's formula $(CaMn)Si_3O_8(MnOH)_2.\ H_2O$. Both formulæ agree with the analyses approximately, but the latest analysis, that of Lundell,* is better represented by the following mixture:

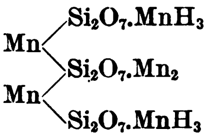


$$\begin{matrix} & Si_2O_7.CaH_3 \\ Ca & \\ & Si_2O_7.Ca_2 \\ Ca & \\ & Si_2O_7.CaH_3 \end{matrix} + 2H_2O, \text{ and } \begin{matrix} & Si_2O_7.MnH_3 \\ Mn & \\ & Si_2O_7.Mn_2 \\ Mn & \\ & Si_2O_7.MnH_3 \end{matrix} + 2H_2O$$

which requires:

	Found, Lundell.	Calculated.
SiO_2	42.92	42.18
PbO	.73	
MnO	36.31	37.44
MgO	.37	
CaO	8.68	9.84
H_2O	10.48	10.54
	99.49	100.00

With inesite another manganese silicate, bementite, is perhaps related, having the formula



$$\begin{matrix} & Si_2O_7.MnH_3 \\ Mn & \\ & Si_2O_7.Mn_2 \\ Mn & \\ & Si_2O_7.MnH_3 \end{matrix}$$

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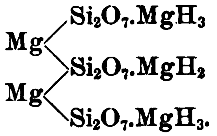
*See Hamberg, Geol. Fören. Förhandl., XVI, p. 325.

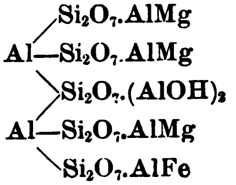
and the magnesian spadaite may be similar, with the composition



$$\begin{array}{ll} & \mathrm{Si_2O_7.MgH_3} \\ \mathrm{Mg} & \\ & \mathrm{Si_2O_7.MgH_2} \\ \mathrm{Mg} & \\ & \mathrm{Si_2O_7.MgH_3.} \end{array}$$

Another magnesian silicate, saponite, is perhaps normally $H_4(MgOH)_2Si_2O_7$, although the analyses all show admixtures of some aluminous compound.

Among the silicates of aluminum, salts of diorthosilicic acid are very rare. The only one which seems to be at all well defined is iolite, which agrees best with the formula

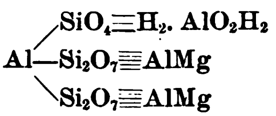


$$\begin{array}{ll} & \mathrm{Si_2O_7.AlMg} \\ \mathrm{Al} & \mathrm{-Si_2O_7.AlMg} \\ & \mathrm{Si_2O_7.(AlOH)_2} \\ \mathrm{Al} & \mathrm{-Si_2O_7.AlMg} \\ & \mathrm{Si_2O_7.AlFe} \end{array}$$

which requires

SiO_2	49.26
Al_2O_3	33.50
MgO	9.85
FeO	5.91
H_2O	1.48
	100.00

in close concordance with the best recorded analyses. By alteration, iolite passes into mica, going through an intermediate stage, however, known as chlorophyllite. This substance may be regarded as formed by hydration, in which the linking group of Si_2O_7 in iolite is split into two orthosilicic radicles, yielding two molecules of the type



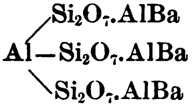
$$\begin{array}{ll} & \mathrm{SiO_4 \equiv H_2.\ AlO_2H_2} \\ \mathrm{Al} & \mathrm{-Si_2O_7 \equiv AlMg} \\ & \mathrm{Si_2O_7 \equiv AlMg} \end{array}$$

from which the final transition into a mica is easy. If we take Rammelsberg's analysis of chlorophyllite, recalculate the ferric oxide into alumina and lime into magnesia, reducing afterwards to 100 per cent, we get the following comparison between observed fact and the composition of chlorophyllite computed from the foregoing formula:

	Found.	Reduced.	Calculated.
SiO_2	46.31	47.99	48.39
Al_2O_3	25.17	33.34	32.90
Fe_2O_3	10.99		
MgO	10.91	11.74	12.90
CaO	.58		
H_2O	6.70	6.93	5.81
	100.66	100.00	100.00

The agreement is as close as could be reasonably expected. The replacement of a little magnesia by a little water in the original alteration product accounts for the discrepancies.

Two other aluminous silicates possibly belong in this group. One, barylite, is near

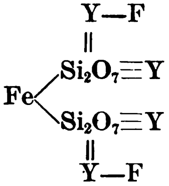


which requires

SiO_2	35.19
Al_2O_3	19.94
BaO	44.87
	100.00

The other silicate, sphenoclase, is approximately $Al_2(Si_2O_7)_3Ca_6$; which may be analogous to barylite in structure, or written as a calcium salt similar in type to okenite. Both barylite and sphenoclase, however, are uncertain, and their relations are not definitely known. The species glauconite, pholidolite, and celadonite, all of doubtful composition, seem also to have diorthosilicate ratios.

To the rare mineral rowlandite, in accordance with Hillebrand's analysis,* a diorthosilicate formula belongs, viz:



which expresses the composition of the species very closely.

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* Bull. U. S. Geol. Survey No. 113, p. 45.

CHAPTER VII.

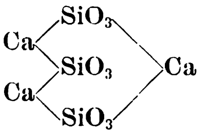
THE META- AND DIMETASILICATES.

Although the metasilicates appear at first sight to be extremely simple, they are actually quite difficult to interpret. It is easy enough to deduce their empirical formulæ, and to write them afterwards in structural terms; but this is not sufficient. The structural formulæ must express all known relations in the case of each species, and in attempting to satisfy the established conditions the difficulties begin to appear. In the first place, metasilicic acid itself is defectively known, and no ether of the form R_2SiO_3 has yet been certainly obtained. Troost and Hautfeuille's ether $(C_2H_5)_8Si_4O_{12}$ suggests the possibility that metasilicic acid, like metaphosphoric acid, may polymerize, but an attempt to draw general conclusions on so important a supposition from one datum only would be most unwise. The possibility of polymeric acids, however, must be recognized.

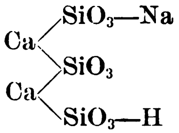
Again, as we have repeatedly seen, a mineral may be apparently a metasilicate and yet really a mixture of ortho- and trisilicates. Even a basic trisilicate can have seemingly metasilicate ratios. All of these considerations complicate the identification and study of the true metasilicates to such an extent that only provisional conclusions can be drawn from the data now on hand.

A crystallized silicate of sodium, $Na_2SiO_3.8H_2O$, is well known. A solution of this salt added to a solution of calcium chloride precipitates a compound which, dried over sulphuric acid, has, according to my own observations, the composition $Ca_2Si_2O_6.5H_2O$. This, minus the water, is analogous to the mineral wollastonite, from which another mineral, pectolite, is derived. If wollastonite, instead of the formula $Ca_2Si_2O_6$, be given the formula $Ca_3Si_3O_9$, it may be compared structurally with pectolite, as follows:

Wollastonite.



Pectolite.

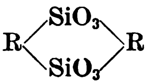


It must be remembered that the molecular weights of the inorganic silicates are not known, but only assumed; and the problem suggested by the foregoing expressions is to find a set of structural formulæ which shall represent all of the available evidence. Now, wollastonite is commonly classed with the pyroxenes, on crystallographic grounds; and so too is pectolite. But both species are very easily decomposed by even dilute and weak acids, while the normal pyroxenes are quite refractory; and furthermore, wollastonite has a lower density than any pyroxene which approaches it in composition. Chemically, then, these species are dissimilar, and it is very doubtful whether they can properly be grouped together.

Empirically, however, the nonaluminous pyroxenes resemble wollastonite in their ratios. Thus we have, according to the commonly accepted formulæ developed by Tschermak, Doelter, and others:

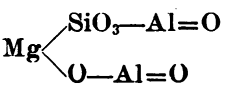
Enstatite, orthorhombic	$Mg_2Si_2O_6$
Diopside, monoclinic	$CaMgSi_2O_6$
Hedenbergite, monoclinic	$CaFeSi_2O_6$
Rhodonite, triclinic	$Mn_2Si_2O_6$

There is also a great variety of other intermediate species or isomorphous mixtures in the pyroxene series, such as bronzite, hypersthene, schefferite, sahlite, jeffersonite, and fowlerite, in which we find, variously replacing one another, salts of magnesium, calcium, iron, manganese, and zinc. All of these minerals, however, conform to the general formula $RSiO_3$, or $R_2Si_2O_6$, which adequately expresses their constitution so far as they alone are concerned. This, structurally, can be written

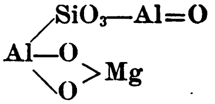


which would be satisfactory if the pyroxene series ended here and if the amphiboles were unknown.

Going a step farther we find in augite a pyroxene containing aluminum, and having an oxygen ratio greater than Si : O_3. In place of aluminum, ferric iron also occurs, and alkalies are sometimes present. Leaving these variations out of account, for consideration later, we have in augite, as interpreted by Tschermak, together with the normal compound $R_2Si_2O_6$, the basic salt $RAlAlSiO_6$; which, as shown by Groth, is empirically analogous to kornerupine. It is also similar in composition to the silicate which is characteristic of the clintonite micas; but the two are probably not identical. A metasilicate isomer of the clintonite molecule might be written either as



or as

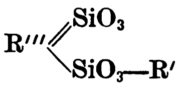


having in the first form some resemblance in structure to the metasilicate formula for the nonaluminous pyroxenes. The compound, however, unless represented by kornerupine, is not known by itself, but is assumed as existent in mixtures; its reality, therefore, is still questionable. Its simplest representation would be as a basic orthosilicate, $Mg(SiO_4)(AlO)_2$, and it will be seen later that a polymer of this form is far more satisfactory than any metasilicate expression.

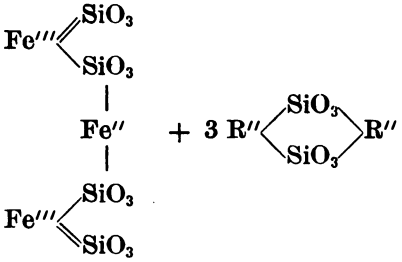
Still another series of silicates containing triad bases and also alkalies are classed with the pyroxenes, as follows:

Spodumene	$AlLiSi_2O_6$
Jadeite	$AlNaSi_2O_6$
Acmite	$Fe'''NaSi_2O_6$

and their empirical formulæ are fairly satisfactory. Structurally, these expressions become, as metasilicates,



and babingtonite, which contains no alkalies, is similar, thus:

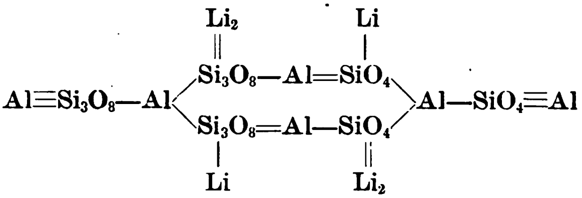


R'' being $=$ Ca, Fe'', and Mn. The ferric molecule is evidently equivalent to two acmite molecules, with Na_2 replaced by a linking atom of iron.

So far, except partially in the comparison between wollastonite and pectolite, the formulæ cited for the pyroxenes express composition and composition only. But spodumene, as shown by the elaborate research of Brush and Dana, splits upon alteration into a mixture of eucryptite, an orthosalt, and albite, a trisilicate. This observation suggests two alternatives: either that spodumene is derived from a polymetasilicic acid, or else that it is a pseudometasilicate, a mixed ortho- and tri-salt, like some of the species which have already been explained. An analogy with leucite, for example, will at once be inferred, and that species, empirically, is strikingly like spodumene, thus:

Leucite	$AlKSi_2O_6$
Spodumene	$AlNaSi_2O_6$

Like spodumene, leucite alters into a feldspar and a member of the nepheline group; but it differs from spodumene in form and in density. The specific gravity of the isometric leucite is 2.5, that of the monoclinic spodumene is nearly 3.2, and hence we may reasonably infer that the latter species has the larger and more condensed molecule. In order to explain the relations of leucite, its empirical formula was quadrupled, and in that way a relation with the garnet group was brought out. For spodumene, regarding it also as a mixed silicate, a sixfold multiplication of its formula indicates its greater density, and its splitting up into eucryptite and albite, with partial replacement of lithium by sodium, is representable as follows:

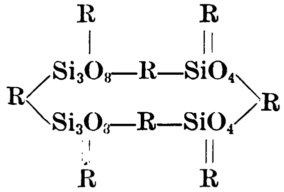


From this grouping of atoms the transition into $Al_3(Si_3O_8)_3Na_3+Al_3(SiO_4)_3Li_3$ is hardly more than a simple case of cleavage, and the relations between the three species are intelligibly expressed. Acmite, which yields pseudomorphs of analcite, and jadeite also, probably follow the same rule, the formula of one being typical of the others. The ferric molecule in babingtonite should be still another instance of the same kind, with Fe''_3 in place of Li_6, and Fe''' instead of Al.

If the formula just developed for spodumene should be sustained, it would seem necessary to adjust the other pyroxenes with it. In the case of Tschermak's aluminous constituent of augite this adjustment is easily made by taking the formula Al_2MgSiO_6 six times, as in the case of spodumene. The parallelism between the two species is then representable as follows:

Spodumene	$Al_6(Si_3O_8)_3(SiO_4)_3Li_6$
Al. augite	$Al_6(SiO_4)_3(SiO_4)_3(AlO_2Mg)_6$

the univalent AlO_2Mg having been recognized among the micas. This formula serves to explain the well-known alterability of augite into epidote and into mica, and so far at least is useful. I do not, however, feel inclined to put very much stress upon it, for as yet it is only an expression of analogy, which may or may not prove to be valid. It would seem to require the recognition of all the pyroxenes as pseudometasilicates, in which case the normal series, containing only dyad bases, would become

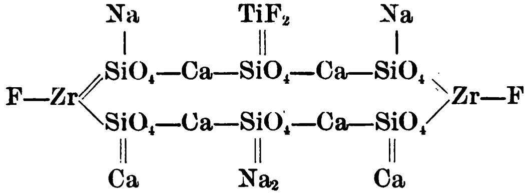


with four atoms of R given linking functions, while the other four are, so to speak, replaceably combined. On this basis we should write

Diopside	$Mg_4Ca_4(Si_3O_8)_2(SiO_4)_2$
Hedenbergite	$Fe_4Ca_4(Si_3O_8)_2(SiO_4)_2$

The formula $R''_4(AlO)_8(SiO_4)_2(SiO_4)_2$ would be exactly parallel with these, and affords another expression for Tschermak's compound Al_2RSiO^6. On the ground of simplicity this is preferable to the more complex expression based on the formula of spodumene.

The so-called "zircon pyroxenes," rosenbuschite, wöhlerite, låvenite, and hiörtdahlite, I have already mentioned among the orthosilicates of zirconium. They can be given metasilicate ratios, following Brögger, by regarding the zirconium as present in the form of a metazirconate. If this explanation is correct, we should expect to find zirconates in nature, free from admixtures; but no such minerals are yet known. Artificial zirconates have, indeed, been prepared; but zirconium is more markedly basic than acid in its functions, and the analogy furnished by the orthosilicate, zircon, has been my guide in the interpretation of these species. Rosenbuschite, however, can be represented as a definite compound having structural analogies with the pyroxenes, as here formulated, with the composition



$$\begin{array}{ccccccccc} & & \mathrm{Na} & & \mathrm{TiF_2} & & \mathrm{Na} & & \\ & & | & & \| & & | & & \\ & & \mathrm{SiO_4} & - \mathrm{Ca} - & \mathrm{SiO_4} & - \mathrm{Ca} - & \mathrm{SiO_4} & & \\ \mathrm{F}-\mathrm{Zr} & \genfrac{}{}{0pt}{}{\diagup}{\diagdown} & & & & & & \genfrac{}{}{0pt}{}{\diagdown}{\diagup} & \mathrm{Zr}-\mathrm{F} \\ & & \mathrm{SiO_4} & - \mathrm{Ca} - & \mathrm{SiO_4} & - \mathrm{Ca} - & \mathrm{SiO_4} & & \\ & & \| & & \| & & \| & & \\ & & \mathrm{Ca} & & \mathrm{Na_2} & & \mathrm{Ca} & & \end{array}$$

which compares well with Cleve's analysis,* thus:

	Found.	Calculated.
SiO_2	31.36	30.30
ZrO_2	20.10	20.54
TiO_2	6.85	6.73
Fe_2O_3	1.00	
La_2O_3	.33	
MnO	1.39	
CaO	24.87	28.29
Na_2O	9.93	10.44
F	5.83	6.40
	101.66	102.70
Less O	2.47	2.70
	99.19	100.00

This mode of interpreting the pyroxenes is so remote from our usual conceptions that I bring it forward with great diffidence. It unifies the group, however, it expresses the observed alterations of the several species, and despite its complexity it will be found to be sustained and strengthened by evidence brought out in the study of the amphiboles.

This last-named group of highly important minerals resembles the pyroxenes in composition, and is explained by Tschermak in essentially the same way. Their molecular weights, however, are taken as double those of the pyroxenes, for the reason that the atomic replacements seem to occur by fourths rather than by halves. This point is exemplified by a comparison between diopside and tremolite; which, reduced to their simplest empirical formulæ, become

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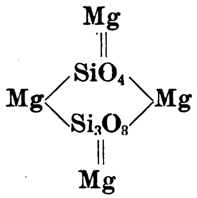
*Zeit. Kryst. Min., XVI, p. 383.

Diopside	$CaMgSi_2O_6$
Tremolite	$CaMg_3Si_4O_{12}$

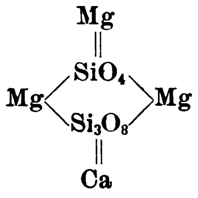
The pyroxenes, however, are somewhat heavier than the amphiboles, and from their greater density we may suppose them to have the larger molecules. Hence the formula of diopside should be a multiple of that just cited, and presumably greater than $Ca_2Mg_2Si_4O_{12}$. Upon this point the phenomenon of uralitization has definite bearing. In this process pyroxene is converted into amphibole, with increase of volume and little or no change of composition. In other words, a complex molecule has been dissociated into simpler molecules—a phenomenon the direct opposite of polymerization. In the face of this evidence it is difficult to see how the current views as to the relative molecular magnitudes of pyroxene and amphibole can be maintained. The pyroxenes must form the more complex group, and the amphiboles the simpler.

In the amphibole group the orthorhombic anthophyllite is the equivalent or isomer of enstatite and hypersthene. Then follows a monoclinic series, containing tremolite, actinolite, cummingtonite, dannemorite, etc., all being represented by the general empirical formula $RSiO_3$, with calcium, magnesium, iron, or manganese as the bivalent metal. In grünerite the salt $FeSiO_3$ exists by itself, and in richterite and astochite alkaline silicates appear. If we regard the minerals as pseudometasilicates, having molecular weights lower than the pyroxenes, and, with the bases replaceable by fourths, the typical amphiboles are most simply represented by formulæ like the following:

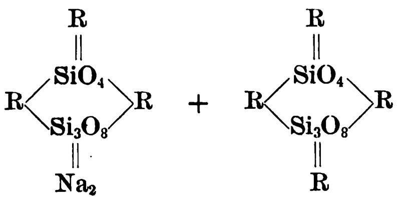
Anthophyllite.



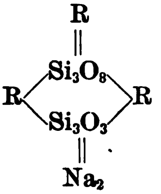
Tremolite.



Richterite becomes a mixture of salts,

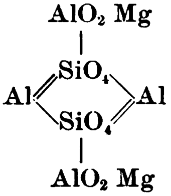


commingled in ratios near 1:1, and astochite is similar, but with NaH in place of Na_2. Potassium may also partly replace sodium. Another alkaline amphibole of doubtful character, waldheimite, approximates to

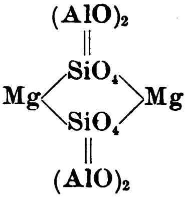


which is the formula of a trisilicate pure and simple, with R=Ca, Fe, Mg. The existence of this compound is strong evidence in favor of the pseudometasilicate theory; and, as will be seen later, it does not stand alone. The formulæ as written suggest a close analogy between the pyroxene-amphibole minerals and the olivine group, which may have some future significance.

Among the amphiboles, as among the pyroxenes, aluminous and ferric compounds are common, and with these the minerals approach to orthosilicate ratios. Tschermak's interpretation of these ratios is practically the same as in the pyroxene series, namely, by the assumption of molecules of the form Al_2RSiO_6 or $Al_4R_2Si_2O_{12}$. An alternative to this view is offered by Scharizer,[*] who shows that the hornblendes can be explained as mixtures of actinolite, $R_4Si_4O_{12}$, with an orthosilicate called syntagmatite $(R'_2R'')_3Al_2(SiO_4)_3$, whose ratios are similar to those of garnet. An amphibole from Jan Mayen's Island approaches very nearly to syntagmatite in composition. If a compound of this type is present in the amphiboles it would explain at once their alterability into epidote, micas, and chlorites; but so far as the composition of the group is concerned neither Tschermak's view nor Scharizer's is absolutely necessary. The Tschermakian molecule, however, can be written either as



or as



the latter form resembling that of tremolite, and also connecting the group still more closely with the olivines. It is also parallel to the last formula suggested for the corresponding pyroxene compound, being one-half of the latter and identical with it in type.

No amphibole is yet known which, by itself, corresponds precisely in its constitution to acmite and spodumene. In glaucophane we find a species, which, as a metasilicate, may be written $AlNaSi_2O_6+(MgFe)SiO_3$; and in crocidolite another similar salt, $Fe'''NaSi_2O_6+FeSiO_3$. Crocidolite alters easily; and one of the products of alteration, which has been named griqualandite, is very near $Fe'''HSi_2O_6$, the equivalent of acmite in general type. This last compound can be written

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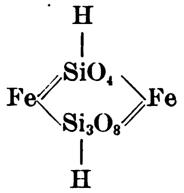
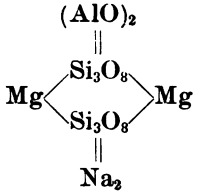
[*] Neues Jahrbuch, 1884, (2), p. 143.

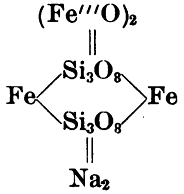


and so adjusted as an amphibole-hydrogen-acmite to the remainder of the group; but glaucophane and crocidolite are best formulated as follows:

Glaucophane.

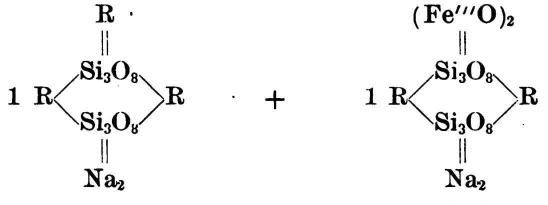


Crocidolite.



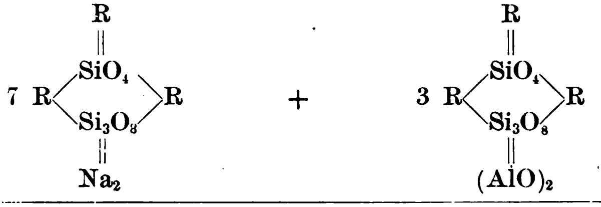
which makes them, as trisilicates, precisely equivalent in structure to the normal amphiboles. These compounds, and their corresponding orthosilicates, commingled with salts like tremolite or actinolite, give mixtures which conform in composition to the aluminous hornblendes.

Closely allied to crocidolite and glaucophane is the recently described amphibole crossite;* in which the ratio of Si:O is distinctly less than 1:3. This species may be written as a mixture of the two molecules



with some Al in place of Fe''', and R being=Fe, Mg, Ca. Gastaldite and riebeckite are similar species, but the analyses are not perfectly conclusive. It is, perhaps, necessary with these minerals to assume the presence of acmite-like molecules, riebeckite being empirically near $2Fe'''NaSi_2O_6+FeSiO_3$.

Arfvedsonite, in which R'' is mainly Fe, may be represented quite closely as a mixture of this order:



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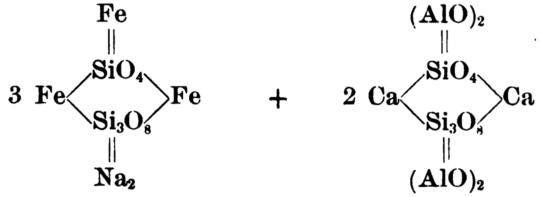
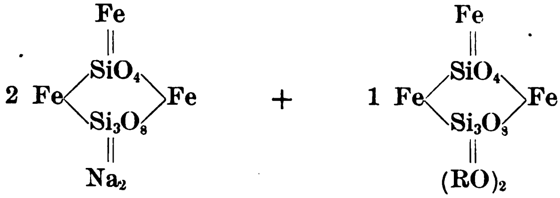
* Palache, Geol. Bulletin, Univ. of California, I, p. 181. 1894.

a little aluminum being replaced by iron. Barkevikite, a more basic species still, has its composition well indicated by the following expression, with some Fe replacing Al as in arfvedsonite:



Finally, in the triclinic aenigmatite, if we assume that the titanium (7.57 per cent TiO_2) is equivalent to silica, we find the mixture



with $RO = AlO : FeO :: 1 : 1$ almost exactly, and $Si : Ti :: 7 : 1$. Calculating with these ratios, ænigmatite has the following composition in comparison with Forsberg's analysis:*

	Found.	Calculated.
SiO_2	37.92	38.11
TiO_2	7.57	7.26
Fe_2O_3	5.81	4.85
Al_2O_3	3.23	3.08
FeO	35.88	39.20
MnO	1.00	
CaO	1.36	
MgO	.33	
Na_2O	6.58	7.50
K_2O	.51	
	100.19	100.00

The variations here are plainly due to the replacements of Fe by Mn, Ca, and Mg, and of Na by K.

A careful study of the best analyses in the pyroxene and amphibole groups will strengthen very materially the view here developed that the species are not true metasilicates. Although in most cases the approximation to metasilicate ratios is very close, there are distinct variations toward orthosilicates on one side and toward trisilicates on the other, and it is only by assuming that we have mixed silicates to deal with that all the anomalies can be made to disappear. On this theory, if we represent Si_3O_8 and SiO_4 groups indiscriminately by the general symbol X, all of the amphiboles are covered by the following typical symbols, in which R'' stands for any dyad metal, and R' for K, Na, H, AlO, or $Fe'''O$:

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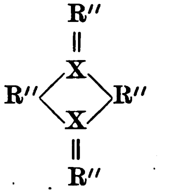
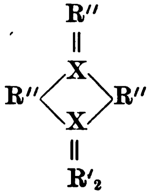
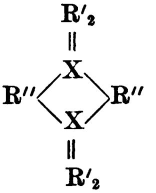
*Zeit. Kryst. Min., XVI, p. 428.

$$R''_4X_2$$
$$R''_3X_2R'_2$$
$$R''_2X_2R'_4$$

or, structurally,





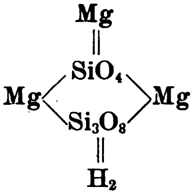


In a similar way, all the pyroxenes, except the acmite-spodumene group, which has the special formula discussed previously, may be represented as formed by mixtures of

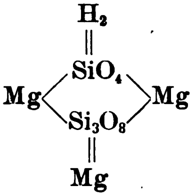
$$R''_4X_4R''_4$$
$$R''_4X_4(R'''O)_8$$

which is in accordance with the theory developed by Tschermak except as to the molecular magnitude of the compounds—that is, the pyroxenes are essentially bipolymers of the amphiboles, and the character of the structure is the same for both groups. The olivine minerals are represented by similar orthosilicate formulæ, $R_4(SiO_4)_2$ being the constitutional equivalent of $R_4(SiO_4)(Si_3O_8)$. Pseudomorphs of pyroxene (fassaite) after monticellite, have been found at Monzoni, and are well known. Furthermore, Becke* has described pseudomorphs of anthophyllite and actinolite after olivine, so that a connection between the two groups is clearly indicated. The tracing of this connection in a more general way would seem to offer a profitable field for investigation.

By the hydration of pyroxene or amphibole either serpentine or talc may be generated. The latter species has the composition $H_2Mg_3Si_4O_{12}$, and may be written structurally like amphibole either



or



Both expressions are in accord with the fact recorded by Schneider and myself,† that upon the ignition of talc one-fourth of the silica is set free quantitatively. This would give the ignited residue the composition shown by the subjoined alternative formulæ:

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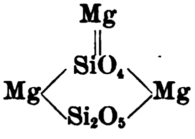
* Min. Pet. Mitth. (N. F.), 4, pp. 355 and 450.

† Bull. U. S. Geol. Survey No. 78, p. 13.



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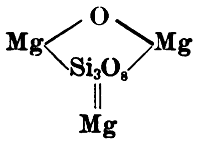
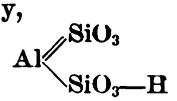


and of these the first would seem to accord the better with the remarkable stability and insolubility of the material. A metasilicate formula, $H_2Mg_3(SiO_3)_4$, is also admissible, and accords equally well with the evidence concerning talc. The pseudometasilicate expression, however, seems to be preferable in view of what is known as to the genesis of the species.

Pyrophyllite and kyanite are two aluminous metasilicates which seem to be related; at all events the former is not infrequently the gangue or matrix of the latter. Empirically they are

Pyrophyllite	$AlHSi_2O_6$
Kyanite	Al_2SiO_5

or, structurally,



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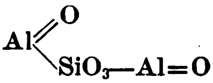
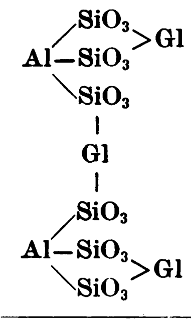


To these formulæ I attach very little significance, except in so far as they represent a single observed relation. Probably the true formulæ should be multiples of these; for kyanite is much denser than its isomer, andalusite, $Al_3(SiO_4)_3(AlO)_3$. Both kyanite and andalusite, at very high temperatures, are transformed, with disengagement of heat, into a third isomer, sillimanite,* a phenomenon which indicates dissociation. Sillimanite doubtless has the smallest molecule of the three species, and may be $Al{\equiv}SiO_4{—}AlO$, but even this is so purely hypothetical that it would be useless at present to discuss the species farther.

With beryl, $Gl_3Al_2Si_6O_{18}$, the evidence in favor of a metasilicate structure is fairly good, although the composition can also be expressed as that of a basic trisilicate. There are thus two alternatives,



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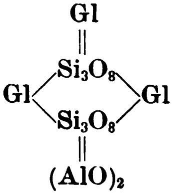

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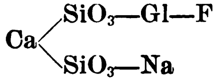
* Vernadsky, Bull. Soc. Min., XII, p. 447, and XIII, p. 256.

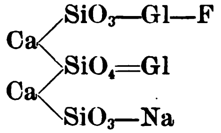
But beryl alters into mica, a fact which is favorable to the first of these formulæ, and all of its commoner alterations seem to take place by replacement of glucinum. In the trisilicate formula the alumina should be equally replaceable, and so far the evidence is adverse to it. Furthermore, Traube* has effected the synthesis of beryl by precipitating a mixture of glucinum and aluminum sulphates with a solution of sodium metasilicate, and then crystallizing by fusion of the precipitate with boron trioxide. Since the starting point was a metasilicate, there is a fair presumption that the product was a metasilicate also. Beryl can be written as a pseudometasilicate, but there are no data to justify doing so.

Two other minerals containing glucinum, leucophanite, and meliphanite, appear to be essentially metasilicates with the subjoined formulæ:

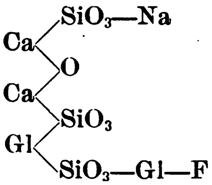
Leucophanite	$NaCaGlFSi_2O_6$
Meliphanite	$NaCa_2Gl_2FSi_3O_{10}$

These are capable of several interpretations. The simplest regards meliphanite as a mixed meta- and orthosilicate, when both species can be written





or else with the glucinum as the linking element, and with the calcium united to fluorine. This involves no change of type, but only an exchange of position between Ca and Gl. Brögger,† to whom the empirical formulæ are due, also represents meliphanite as a basic metasilicate



which is also justifiable. Between the several alternatives there is no ground for deciding. The stability of meliphanite toward ordinary acids would seem to favor the formula first given, for a basic calcium salt would probably be more easily decomposable.

Danburite, $CaB_2Si_2O_8$, is sometimes regarded as the equivalent of barsowite, $CaAl_2Si_2O_8$, a doubtful isomer of anorthite. But barsowite gelatinizes with hydrochloric acid, while danburite is attacked by the reagent only after ignition. Possibly the difference may be as follows:

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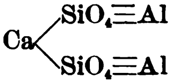
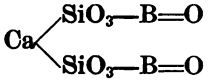
* Neues Jahrbuch., 1894, I, p. 275.

† Zeit. Kryst. Min., XVI, pp. 289–291.



$$\mathrm{Ca}\left<\begin{array}{l}\mathrm{SiO_4{\equiv}Al}\\ \mathrm{SiO_4{\equiv}Al}\end{array}\right.$$

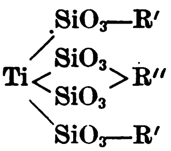


$$\mathrm{Ca}\left<\begin{array}{l}\mathrm{SiO_3{-}B{=}O}\\ \mathrm{SiO_3{-}B{=}O}\end{array}\right.$$

danburite being a metasilicate. Other formulæ are also possible, and more data are needed before any conclusion can be reached. The associations of danburite with feldspars, mica, pyroxene, etc., suggest that it may be a pseudometasilicate, allied in structure to the aluminous constituent of augite.

Chrysocolla is probably a metasilicate, and perhaps, empirically, $CuSiO_3.2H_2O$. It can not be well regarded as impure dioptase, for the latter gelatinizes with hydrochloric acid, while chrysocolla does not. The species, which may be a mixture of compounds, needs careful investigation.

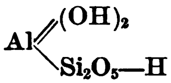
Among the titanosilicates, the recently described neptunite* appears to be a meta compound,



$$\mathrm{Ti}\left<\begin{array}{l}\mathrm{SiO_3{-}R'}\\ \mathrm{SiO_3}\\ \mathrm{SiO_3}\\ \mathrm{SiO_3{-}R'}\end{array}\right.\quad \mathrm{SiO_3}, \mathrm{SiO_3} > \mathrm{R''}$$

with $R'=Na, K$, and $R''=Fe, Mn$. The analogy between this formula and the formulæ of the titanium orthosilicates is its sole justification. The ratios given by analysis, however, are sharply in accord with the proposed expression.

The salts which are fairly ascribable to dimetasilicic acid, $H_2Si_2O_5$, are few in number and comparatively rare. Among them, petalite, $AlLi(Si_2O_5)_2$, is the best known and most characteristic. Its formula, as here written, is closely similar to the metasilicate formula for spodumene, and the two species are commonly associated. Petalite, however, has far the lower density of the two, and is therefore presumably composed of smaller molecules. An alteration product of petalite, hydrocastorite, approximates roughly to



$$\mathrm{Al}\left<\begin{array}{l}\mathrm{(OH)_2}\\ \mathrm{Si_2O_5{-}H}\end{array}\right.$$

which requires

SiO_2	60.60
Al_2O_3	25.75
H_2O	13.65
	100.00

The actual hydrocastorite contains about 4.3 per cent of lime, and is doubtless impure. By Doelter† petalite is interpreted somewhat differently, being given the empirical formula $Al_2Li_2Si_{10}O_{24}$; but the formula here adopted is the one most generally received.

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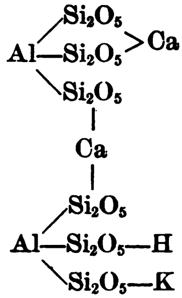
* Flink. Geol. Fören. Förhandl., XV, p. 196.

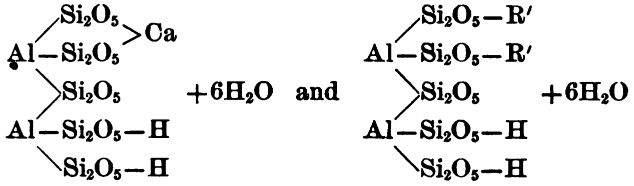
† Min. Pet. Mitth., 1878, I, p. 529.

Milarite, $HKCa_2Al_2(Si_2O_5)_6$, is, like beryl, hexagonal; and its formula is analogously to be written



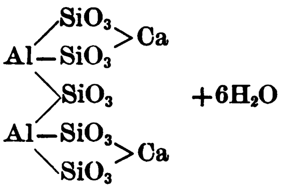
For this species the only evidence is that of its composition. Its genesis and its possible alterations are unknown.

The two closely allied zeolitic minerals, mordenite and ptilolite, are also to be classed as dimetasilicates. Their constitution, which I have fully discussed elsewhere,* is easily expressed by regarding both minerals as mixtures of the two molecules



in which R′ = Na or K. In one occurrence of ptilolite the water is lower than is required by these formulæ, and it seems probable that a trihydrate may exist.

The metasilicate zeolite, laubanite, is the precise equivalent of ptilolite and mordenite, and is easily interpreted thus:



Pilinite, a similar mineral, seems to be $Al_2(SiO_3)_5Ca_2.H_2O$, a monohydrate corresponding to the hexhydrated laubanite. Unlike laubanite, pilinite is undecomposed by hydrochloric acid; but physically all four of the species here grouped together resemble one another very closely.

The rare mineral hyalotekite, which contains boron, agrees very closely with the empirical formula $R''_4BFSi_6O_{17}$, if we regard the water in it as hydroxyl replacing fluorine. This can be interpreted either as a dimetasilicate or as a trisilicate, with the following alternative formulæ:

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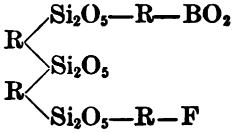
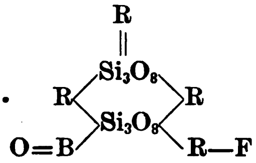
* Am. Jour. Sci., August, 1892.



or



Its association with feldspar and schefferite rather favors the trisilicate formula, but the two are empirically identical. If we reduce Lindström's analysis to 100 per cent, after calculating the water (ignition) into its equivalent of fluorine, rejecting as impurities the traces of Al_2O_3 and Fe_2O_3, and consolidating like bases, we get the following comparison with theory:

	Found.	Reduced.	Calculated.
SiO_2	39.47	38.60	38.10
B_2O_3	3.73	3.63	3.71
PbO	25.11	25.71	26.22
CuO	.09		
MnO	.29		
GlO	.75		
Na_2O	.17		
CaO	7.82	9.43	9.22
BaO	20.08	21.32	21.59
MgO	.09		
K_2O	.89		
Al_2O_3	.18	....	....
Fe_2O_3	.06	....	....
F	.99		
Cl	.06	2.26	2.01
Ign	.59		
	100.37	100.95	100.85
Less O	....	.95	.85
		100.00	100.00

In computing, R″ has been regarded as Ca:Ba:Pb::7:6:5—that is, hyalotekite is a mixture of isomorphous calcium, barium, and lead salts in the indicated ratio. The agreement between analysis and theory is as close as could be reasonably expected.

There still remain a few natural silicates which are definitely recognized as species, but which do not fall distinctly into any one of the chapters of this work. Their constitution is obscure, and I shall not attempt to discuss them. Still, they may properly be recorded at this point for the sake of completeness.

Cuspidine.—A fluosilicate of calcium, supposed to be orthosilicate in structure. It may be allied to chondrodite, but it has not yet been completely analyzed.

Långbanite.—A silicate of manganese and iron containing antimony. Allied on crystallographic grounds to the oxides hematite and ilmenite.

Uranophane.—Composition represented by the empirical formula $CaU_2Si_2O_{11}.6H_2O$.

Thaumasite.—$CaSiO_3,CaSO_4,CaCO_3,15H_2O$. To the molecular constitution of this extraordinary substance there is as yet no tangible clew. A structural formula can be assigned to it, but would be meaningless.

Neotocite.—Hydrous silicates of manganese and iron, of variable composition. Several distinct compounds are probably covered by this name.

A multitude of other silicates have been described as species, but without, as yet, securing full recognition. Some of these are doubtless mixtures, or impure varieties of well known minerals; while others may be ultimately established as good and definite compounds. A discussion of the records, without experimental investigation of the various minerals, would have very uncertain value. I therefore omit these doubtful species from consideration.

CHAPTER VIII.

SUMMARY.

The formulæ developed in the body of this memoir are so varied and so interlinked, one with another, that a summary of them in concise form seems to be desirable. I accordingly append such a summary, with occasional notes intended to make the subject, if possible, more clear.

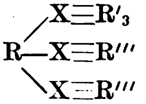
1. *Ortho- and trisilicates of triad bases.*

A. Normal salts.

Xenolite	$Al_4(SiO_4)_3$(?)
Samoite	$Al_4(SiO_4)_3.10H_2O$(?)
Cimolite	$Al_4(Si_3O_8)_3.6H_2O$(?)
Anthosiderite	$Fe_4(Si_3O_8)_3.2H_2O$(?)
Pseudobrookite	$Fe_4(TiO_4)_3$
Eulytite	$Bi_4(SiO_4)_3$
Agricolite	

Of these species the last three are definitely established, but the others are more or less uncertain.

B. First substitution series.

Type 

$$\mathrm{R}\begin{array}{l} \diagup \mathrm{X}\equiv\mathrm{R}'_3 \\ —\mathrm{X}\equiv\mathrm{R}''' \\ \diagdown \mathrm{X}\equiv\mathrm{R}''' \end{array}$$

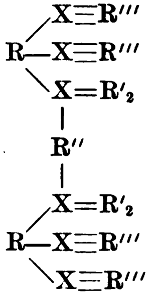
Eucryptite	$Al_3(SiO_4)_3Li_3$
Nephelite	$Al_3(SiO_4)_3Na_3$
Kaliophilite	$Al_3(SiO_4)_3K_3$
Kryptotile	$Al_3(SiO_4)_3H_3$(?)
Albite	$Al_3(Si_3O_8)_3Na_3$
Orthoclase	$Al_3(Si_3O_8)_3K_3$
Paragonite	$Al_3(SiO_4)_3NaH_2$
Muscovite	$Al_3(SiO_4)_3KH_2$
Andalusite	$Al_3(SiO_4)_3(AlO)_3$
Sillimanite	
Topaz	$Al_3(SiO_4)_3(AlF_2)_3$
Kornerupine*	$Al_3(SiO_4)_3(AlO_2Mg)_3$
Rectorite	$Al_3(SiO_4)_3H_3.2H_2O$(?)
Hydronephelite	$Al_3(SiO_4)_3Na_2H.3H_2O$

---

*Doubtful. Compare with formulæ given for pyroxenes and amphiboles.

Offretite	$\left[\begin{array}{l}2Al_3(Si_3O_8)_3K_2H.8H_2O\\1Al_3(SiO_4)_3CaH.8H_2O\end{array}\right]$
Gmelinite	$Al_3(SiO_4)(Si_3O_8)_2Na_3.9H_2O$
Soda chabazite	

Double type

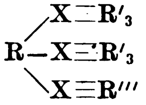


Anorthite	$Al_6(SiO_4)_6Ca_3$
Meionite	$Al_6(SiO_4)_6Ca_2.(CaOCa)$
Thomsonite	$Al_6(SiO_4)_6Ca_3.7H_2O$
Gismondite	$Al_6(SiO_4)_6Ca_3.12H_2O$
Phillipsite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_2K_2.14H_2O$
Levynite	$Al_6X_6Ca_3.15H_2O$
Heulandite	$Al_6(Si_3O_8)_6Ca_3.16H_2O$
Epistilbite	
Stilbite	$Al_6(Si_3O_8)_6Ca_3.18H_2O$
Chabazite	$Al_6(SiO_4)_3(Si_3O_8)_3Ca_3.18H_2O$

Also the barium feldspars, and the barium-strontium zeolites harmotome and brewsterite. X represents the tetrad groups SiO_4 and Si_3O_8 indiscriminately.

C. Second substitution series.

Type



Natrolite	$Al_2(SiO_4)_3Na_2H_4$
Dumortierite	$Al_2(SiO_4)_3(AlO)_6$
Zunyite	$Al_2(SiO_4)_3R'_6$
Chloropal	$Fe_2(SiO_4)_3H_6$
Cancrinite	$Al_2(SiO_4)_3Na_4H(AlCO_3)$
Microsommite	$Al_2(SiO_4)_3CaR'_4$
Prehnite	$Al_2(SiO_4)_3Ca_2H_2$
Arctolite	$Al_2(SiO_4)_3CaMgH_2$
Biotite	$Al_2(SiO_4)_3Mg_2KH$
Siderophyllite	$Al_2(SiO_4)_3Fe_2KH$
Biotite-vermiculite	$Al_2(SiO_4)_3Mg_2H_2.3H_2O$
Biotite-chlorite	$Al_2(SiO_4)_3(MgOH)_4H_2$
Scolecite	$Al_2(SiO_4)_3CaH_4.H_2O$
Sodalite	$Al_2(SiO_4)_3Na_4(AlCl)$

Haüynite	$Al_2(SiO_4)_3Na_2Ca(AlSO_4Na)$
Nosite	$Al_2(SiO_4)_3Na_4(AlSO_4Na)$
Lazurite	$Al_2(SiO_4)_3Na_4(AlS_3Na)$
Garnet group	$R'''_2(SiO_4)_3R''_3$
Epidote group	$R'''_2(SiO_4)_3R''_2(R'''OH)$
Leucite	$Al_2(SiO_4)(Si_3O_8)_2K_4(AlSiO_4Al)$
Analcite	Similar to leucite.
Pollucite	Similar to leucite.
Marialite	$Al_2(Si_3O_8)_3Na_4(AlCl)$

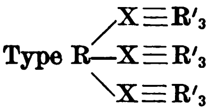
Double type, $R'''_4X_6R''_6$.

Mesolite	$Al_4(SiO_4)_6CaNa_2H_8.H_2O$
Foresite	$Al_4(SiO_4)_6CaH_{10}.H_2O$

Conjugate type, $R'''_2X_5R''_7$.

Vesuvianite	$Al_2(SiO_4)_5R''_6(AlOH)$
Gehlenite	$Al_2(SiO_4)_5R''_6(AlO_2Mg)_2$
Melilite	$Al_2(SiO_4)_4(SiO_3)R''$

D. Third substitution series.



$$\text{Type } R\left\{\begin{array}{l}-X\equiv R'_3\\-X\equiv R'_3\\-X\equiv R'_3\end{array}\right.$$

Phlogopite	$Al(SiO_4)_3Mg_3KH_2$
Phlogopite-vermiculite	$Al(SiO_4)_3Mg_3H_3.3H_2O$
Phlogopite-chlorite	$Al(SiO_4)_3(MgOH)_6H_3$
Manganophyll	$(AlFe)(SiO_4)_3(MnMg)_3KH_2$
Ganophyllite	$AlX_3Mn_3R'_3.2H_2O$
Stilpnomelane	$Al(Si_3O_8)_3(FeOH)_6H_3$
Faujasite	$Al(Si_3O_8)_3R'_5R''_2.15H_2O$
Cerite	$Ce(SiO_4)_3(CeO)_3H_6$

Double type, $R'''_2X_6R'_{18}$.

Staurolite	$Al_2(SiO_4)_6Fe''_3(AlO)_{12}$
Harstigite	$Al_2(SiO_4)_6Ca_5Mn_2H_4$

E. Basic salts.

Westanite	$AlOH(SiO_4)_2Al_2$
Kaolin	$AlOH(SiO_4)_2AlH_3$
Montmorillonite	$AlOH(SiO_4)_2H_6$
Newtonite	$Al(OH)_2(SiO_4)H_3$
Margarite	$AlOH(SiO_4)_2CaH(AlO)_3$
Strigovite	$AlOH(SiO_4)_2AlH(FeOH)_2$
Aphrosiderite	$AlOH(SiO_4)_2Al(FeOH)_3$
Lepidolite type	$AlF_2(Si_3O_8)R'_3$
Cookeite type	$Al(OH)_2(SiO_4)R'_3$
Clintonite type	$AlO_2Mg(SiO_4)R'_3$
Clintonite-vermiculite	$AlO_2Mg(SiO_4)R'_3.3H_2O$
Chloritoid	$AlO_2Fe(SiO_4)H(AlOH)$
Ottrelite	$AlO_2Fe(Si_3O_8)H(AlOH)$

With many members of the chlorite group, such as prochlorite, leuchtenbergite, etc.

F. Borosilicates, etc.

Tourmaline, A	$Al_8(SiO_4)_6(BO_3)(BO_2)_2R'_5$
Tourmaline, B	$Al_7(SiO_4)_6(BO_3)(BO_2)_2Mg_2R'_4$
Tourmaline, C	$Al_6(SiO_4)_6(BO_3)(BO_2)_2Mg_3R'_5$
Tourmaline, D	$Al_5(SiO_4)_6(BO_3)(BO_2)_2Mg_4R'_6$
Axinite	$Al(SiO_4)(Si_3O_8)(BO_3)Ca_3(AlOH)$

And the species cappelinite, karyocerite, melanocerite, and tritomite.

G. Complex silicates.

Spodumene	$Al_6(Si_3O_8)_3(SiO_4)_3Li_6$
Jadeite	$Al_6(Si_3O_8)_3(SiO_4)_3Na_6$
Acmite	$Fe_6(Si_3O_8)_3(SiO_4)_3Na_6$
And in babingtonite the molecule	$Fe'''_6(Si_3O_8)_3(SiO_4)_3Fe''_3$

To this group of triad silicates, the largest and most important group of all, other species belong which I have not clearly interpreted. Such species are halloysite, allophane, collyrite, schrötterite, sapphirin, ardennite, carpholite, cenosite, sarcolite, etc. The formulæ of the tabulated species must all be construed in a general way—that is, with common replacements of aluminum by ferric iron, magnesium by ferrous iron, and so on. In every case details are suppressed, and these are to be found in the text. The same rule applies to the species in the groups which follow:

2. *Ortho- and trisilicates of dyad bases.*

Forsterite	$n.Mg_2SiO_4$
Fayalite	$n.Fe_2SiO_4$
Tephroite	$n.Mn_2SiO_4$
Willemite	$n.Zn_2SiO_4$
Phenakite	$n.Gl_2SiO_4$
Monticellite	$CaMgSiO_4$
Knebelite	$MnFeSiO_4$
Hyalosiderite	$Mg_4Fe_2(SiO_4)_3$
Igelströmite	$Fe_4Mn_2(SiO_4)_3$
Trimerite	$Gl_3Mn_2Ca(SiO_4)_3$
Chondrodite	$Mg_3(SiO_4)_2(MgF)_2$
Humite	$Mg_5(SiO_4)_3(MgF)_2$
Clinohumite	$Mg_7(SiO_4)_4(MgF)_2$
Helvite	$Gl_3R''_2(SiO_4)_3(R—S—R)$
Danalite	
Bertrandite	$Gl_3(SiO_4)_2H(GlOH)$
Calamine	$Zn_2(SiO_4)_2H_2(ZnOH)_2$
Lievrite	$Fe_2Ca(SiO_4)_2(AlOH)$
Datolite	$Ca_2(SiO_4)_2H_2(BO)_2$
Homilite	$Ca_2Fe(SiO_4)_2(BO)_2$

Euclase	$Gl_2(SiO_4)_2H_2(AlO)_2$
Gadolinite	$Gl_2Fe(SiO_4)_2(YO)_2$
Friedelite	$R''_4(SiO_4)_4H_7(R''Cl)$
Pyrosmalite	
Dioptase	$n.CuH_2SiO_4$
Karyopilite	$Mn_3(SiO_4)_3H_5(MnOH)$
Villarsite	$Mg_3(SiO_4)_2H(MgOH)$
Serpentine	$Mg_2(SiO_4)_2H_3(MgOH)$
Picrosmine	$Mg_2(SiO_3)(SiO_4)H_2$
Aphrodite	$Mg_2(SiO_4)_2H_4$
Kerolite	$Mg(SiO_4)_2H_5(MgOH)$
Deweylite	$Mg_2(SiO_4)_3H_6(MgOH)_2.2H_2O$
Eudidymite	$HNaGlSi_3O_8$
Epididymite	

3. *Ortho- and trisilicates of tetrad bases.*

Zircon	$n.ZrSiO_4$
Thorite	$n.ThSiO_4$(?)
Auerbachite	$Zr_4(SiO_4)_3(Si_3O_8)$
Malacone	$Zr_3(SiO_4)_3(OH)H$
Eudialyte	$ZrX_3Cl.Ca_3Na_3$
Elpidite	$Zr(Si_3O_8)_2(OH)_2Na_2H_4$
Catapleiite	$Zr(Si_3O_8)(OH)_3Na_3$
Wöhlerite	$Zr(SiO_4)_4R''_5Na_2$
Yttrialite	$Th(Si_3O_8)_4Fe''_2(YO)_8$
Astrophyllite	$Ti(SiO_4)_4Fe''_4R'_4$
Johnstrupite	$Ti(SiO_4)_4Ca_4(CeF_2)Na_2H$
Sphene	$Ca(SiO_4)(TiO)$

With rosenbuschite, låvenite, and hiörtdahlite, allied to wöhlerite; rinkite and mosandrite, allied to johnstrupite; and keilhauite and tscheffkinite, allied to sphene.

4. *The diorthosilicates.*

Barysilite	$Pb_3(Si_2O_7)$
Melanotekite	$Pb_2(Si_2O_7)(Fe'''O)_2$
Kentrolite	$Pb_2(Si_2O_7)(Mn'''O)_2$
Ganomalite	$(PbCa)_3(Si_2O_7)$
Okenite	$Ca_3(Si_2O_7)_3H_{12}$
Gyrolite	$Ca_4(Si_2O_7)_3H_{10}$
Apophyllite	$Ca_2(Si_2O_7)_3H_{12}(CaOH)_2$
Plombierite	$Ca_6(Si_2O_7)_3H_6.\ 9H_2O$
Inesite	$R_6(Si_2O_7)_3H_6.\ 2H_2O$
Bementite	$Mn_6(Si_2O_7)_3H_6$
Spadaite	$Mg_5(Si_2O_7)_3H_8$
Saponite	$(MgOH)_2H_4(Si_2O_7)$.(?)
Iolite	$Al_6(Si_2O_7)_5Mg_4(AlOH)_2$

Barylite	$Al_4(Si_2O_7)_3Ba_3$
Sphenoclase	$Al_2(Si_2O_7)_3Ca_6$
Rowlandite	$Fe''(Si_2O_7)_2Y_2(YF)_2$

5. *The metasilicates.*

Laubanite	$Al_2(SiO_3)_5Ca_2.6H_2O$
Talc*	$Mg_3(SiO_3)_4H_2(?)$
Pyrophyllite	$Al(SiO_3)_2H$
Kyanite	$AlO(SiO_3)(AlO)$
Beryl	$Al_2Gl_3(SiO_3)_6$
Leucophanite	$Ca(SiO_3)_2Na(GlF)$
Meliphanite	$Ca_2(SiO_3)_2(SiO_4)GlNa(GlF)$
Wollastonite	$Ca_3(SiO_3)_3$
Pectolite	$Ca_2(SiO_3)_3NaH$
Danburite	$Ca(SiO_3)_2(BO)_2$
Chrysocolla	$CuSiO_3.2H_2O(?)$
Neptunite	$Ti(SiO_3)_4R''R'_2$

Leucite, pollucite, analcite, eudialyte, etc., have been treated as pseudometasilicates. To these species must be added the pyroxenes and the amphiboles, with the following general formulæ:

Pyroxene	$R''_8(SiO_4)_2(Si_3O_8)_2$
Amphibole	$R''_4(SiO_4)(Si_3O_8)$

Glaucophane and crocidolite may be written

$$R''_2(Si_3O_8)_2(R'''O)_2Na_2$$

or all trisilicate, and crossite, waldheimite, etc., seem to be similar. The evidence for these expressions appears in the text.

6. *The dimetasilicates.*

Petalite	$Al(Si_2O_5)_2Li$
Milarite	$Al_2(Si_2O_5)_6HKCa_2$
Mordenite Ptilolite	$Al_2(Si_2O_5)_5CaH_2.6H_2O$ $Al_2(Si_2O_5)_5R'_2H_2.6H_2O$
Hyalotekite	$R''_2(SiO_5)_3(RF)(RBO_2)$

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* Possibly a pseudometasilicate.

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